U. S. DEPARTMENT OF AGRICULTURE.

OFFICE OF EXPERIMENT STATIONS—BULLETIN NO. 141.

A. C. TRUE, Director.

EXPERIMENTS

ON

LOSSES IN COOKING MEAT,

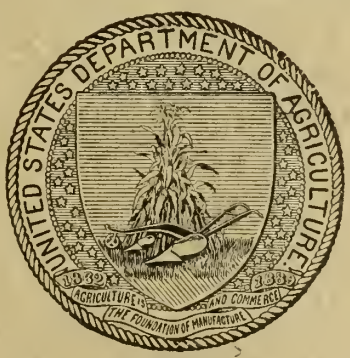
1900-1903.

BY

H. S. GRINDLEY, D. Sc.,
Associate Professor of Chemistry, College of Science, University of Illinois,

AND

TIMOTHY MOJONNIER, M. S.



WASHINGTON:
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1904.

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[Continued on third page of cover.]

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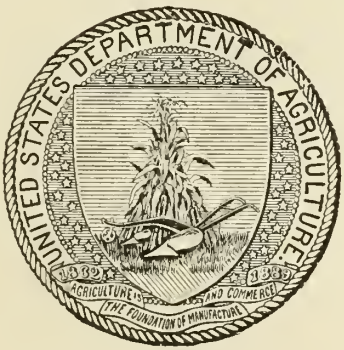

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1904.

OFFICE OF EXPERIMENT STATIONS.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Office of Experiment Stations,
Washington, D. C., January 30, 1904.

Sir: I have the honor to transmit herewith the report of investigations conducted in 1900 to 1903 by Prof. H. S. Grindley, associate professor of chemistry in the College of Science of the University of Illinois, and Timothy Mojonnier, who was at the time an assistant in chemistry at the same institution, the work being conducted under the general supervision of Prof. W. O. Atwater, chief of nutrition investigations, in accordance with instructions given by the Director of this Office. In this, as in Professor Grindley's earlier work, the object has been to secure accurate data regarding the changes which take place in meat when cooked by the ordinary household methods and also the effects of cooking upon nutritive value. The investigations have received material aid from the department of animal husbandry of the Illinois Agricultural Experiment Station, and from the department of household science and the department of chemistry of the University of Illinois. In the experimental and editorial work valuable assistance was rendered by Miss E. C. Sprague, and in the analytical work by F. W. Gill and W. C. E. Braun. The present bulletin, which is considered as a progress report, gives the details of 87 cooking experiments. The results already obtained are of practical value as well as of scientific interest, and the report is submitted with the recommendation that it be published as Bulletin No 141 of this Office.

Respectfully,

A. C. True,
Director.

Hon. James Wilson,
Secretary of Agriculture.

CONTENTS.

INVESTIGATIONS UPON THE COOKING OF MEAT.

INTRODUCTION.

Under the auspices of the Office of Experiment Stations of the United States Department of Agriculture the authors of this bulletin during the last four years have been making, at the University of Illinois, an extended investigation upon the cooking of meats, the object of the work being (1) to study the influence of the cooking of meats upon their digestibility; (2) to determine the nature and the extent of the losses which meats undergo during the cooking; (3) to investigate the nutritive value of cooked meats; (4) to study the character of the changes which take place in meats when they are cooked by the several common methods; and (5) to observe the influence of cooking upon the flavor and palatability of meats.

Investigations on the losses taking place in the cooking of meats, which were carried on at the University of Illinois in 1898 to 1900, have already been published,[a] and the results of a large number of experiments which were undertaken to determine the influence of the cooking of meats upon their total digestibility and upon their ease and rapidity of digestion have been described in part[b] but await publication in full. During the last two years the investigations upon the nature and character of the losses which occur in the cooking of meats have been continued and enlarged, and it is the purpose of the present bulletin to present some of the results which have been obtained.

The work here reported includes (1) 34 experiments made to estimate the character and extent of the losses which result in the cooking of meats in hot water at different temperatures and for different lengths of time, one particular feature being a study of the conditions under which meats may be thus cooked in order to produce the richest broth; (2) 3 experiments to determine the amount and character of the losses which take place when meats are cooked by panbroiling; (3) 3 experiments to estimate the quantity of losses and the nature of the changes resulting when meats are cooked by sautéing; and (4) 32 experiments on the losses of material in roasting meats.

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 102.

[b] The University Studies, University of Illinois, Vol. I, No. 5, p 1.

THE COOKING OF MEAT.

Flesh, which forms a large factor in the nutrition of man, is, with very few exceptions, cooked before it is eaten. Civilized people cook their meat, very largely because it is thus made more palatable and more pleasing in appearance. At the same time the process of cooking serves to destroy animal parasites, if such be present, and to a certain extent bacteria and their products, though it is doubtful if this is often thought of in the ordinary household. It is probable that the increased palatability of cooked meat is due to the loosening and softening of the tissue and to the development during the process of cooking of certain odors and flavors such as those due to browned flesh and fat. However, little can be definitely said regarding the real nature of the changes produced. That this is true is due to the present very incomplete knowledge of the entire subject of the chemical and physical changes which meat undergoes during cooking.

Although cooking, that is, broadly speaking, the preparation of food for the table, is one of the oldest of arts it is not a science, and very little is known of the exact scientific principles which underlie the practice. Experimental data on this subject are not abundant, and perhaps in no field of scientific inquiry is there so much confusion—so much that is mere tradition or so many ideas that are undoubtedly unwarranted—as is found to be the case when the attempt is made to apply science to cooking.

METHODS OF COOKING MEAT.

The methods which are used for cooking meats are many and varied. In fact, meat may be cooked by any of the common methods used in preparing food, namely, boiling, steaming, stewing, braising, roasting, baking, broiling, panbroiling, sautéing, and frying, though in the United States roasting (baking), broiling, boiling, stewing, and frying are most usual. Meats are also used in preparing croquettes, pies, and other made dishes. This part of the subject is important, but can not be taken up here. In common usage the terms which are applied to the processes of cooking vary much as to their meaning, and naturally so, since the processes are not fixed and uniformly followed. This is especially true as regards the temperature required in the several methods of cooking. For example, some authorities give the following directions for the boiling of meat: Plunge the meat at once into boiling water (212° F. or 100° C.), and keep the water at the boiling point, or as near boiling as possible, for ten minutes. Then allow the temperature to fall to about 180° F. (85° C.), and continue the cooking at this temperature for the required time. On the other hand, other authorities insist that the piece of meat be put in boiling water and boiled rapidly fifteen or twenty minutes, and then the cooking com-

pleted at a gentle simmer (202° F. or 94° C.). Still others define boiling as cooking by heat of convection through immersion in liquid (usually water) at its boiling point, that is, when bubbles of steam break rapidly on the surface. It is evident from these examples that the term boiling as used in this connection has quite a different significance with different authorities upon the subject. This is equally true of other terms describing methods of cooking.

It would be desirable to have the nomenclature of the methods of cooking revised and each term given a precise meaning, and, if possible, the temperature best suited for each method of cooking should be stated in the definition. In this revision it would be well to take into consideration, also, the nature of the changes and losses produced by the different methods of cooking.

The methods of cooking used in these experiments are designated as boiling, panbroiling, sautéing, and roasting. For the present, cooking in hot water at any temperature has been called boiling; but in each experiment the temperature of the water during cooking is recorded, so that it will not be difficult to decide, if at any time it is desirable, whether the meat was cooked by stewing, simmering, or true boiling. The method used in cooking the meats by boiling varies so much in detail in the different tests as to procedure, time, and temperature that it can not be described briefly here, but is given in detail in connection with the descriptive and analytical data of the several experiments.

In the panbroiling experiments, the meat was cooked upon the surface of a medium hot, dry, cast-iron frying pan for the desired length of time, which is recorded in every case. No fat was added to the frying pan either before or during the cooking, but the meat was frequently turned. In the sautéing experiments, the meat was cooked for fifteen minutes in a small amount of hot lard, the quantity used being sufficient to form a thin layer upon the bottom of the pan. In this case, also, the meat was frequently turned during the cooking. In the roasting (or baking) experiments, the meat was cooked in a pan in a well-ventilated oven, and the details as to temperature and time of cooking are in every case given in connection with the other descriptive and analytical data.

ANALYTICAL METHODS—COMPOSITION.

The methods followed in these investigations in making the necessary analyses were those recommended by the Association of Official Agricultural Chemists, with such minor modifications[a] as seemed best in view of previous work in this laboratory. Unusual care was taken in preparing for analysis representative samples of the cooked meats, of the broths obtained in the boiling experiments, and of the drip-

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 102, pp. 8–16.

pings from the roasted meat, since successful work manifestly depends upon this feature.

COMPOSITION OF COOKED MEATS.

In order to determine the nature of the changes which take place and the losses which result in the cooking of meats, it is necessary to learn the composition of the cooked meats, of the broth from boiled meat, and of the drippings from roasted meat. Table 1, which follows, gives the results of the analyses of the edible portion of the meats cooked in different ways in the several experiments. In experiments Nos. 19 to 74 the meat was entirely freed from bone before cooking, and in such cases the analyses reported in Table 1 represent the composition of the entire cooked meat, which was all edible. In experiments Nos. 75 to 106, inclusive, the meat used for roasting contained more or less bone, which is, of course, not included in the figures in the table.

TABLE 1.—*Composition of cooked meats (edible portion).*

Laboratory No.	Kind of meat.	Cooking experiment No.	Water.	Nitrogen.	Protein (N×6.25).	Fat.	Ash.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1027	Beef, round, boiled	19	58.16	5.22	32.61	8.38	0.96
1097	.....do	19	56.94	5.03	31.45	10.53	.94
1091	.....do	26	56.45	4.85	30.34	12.84	.90
1092	.....do	26	58.19	4.60	28.74	12.67	.94
1093	Beef, plate, boiled	27	45.41	3.49	21.79	32.32	.68
1094	.....do	27	44.00	3.24	20.22	35.49	.69
1095	Beef, round, boiled	28	51.30	6.41	40.06	7.27	1.08
1096	.....do	28	51.50	6.39	39.95	7.95	.93
1098	.....do	29	53.97	5.25	32.83	12.54	.93
1099	.....do	29	54.10	4.30	26.89	18.18	.91
1169	Beef, ribs, boiled	34	51.70	3.52	21.99	26.04	.62
1170	.....do	34	44.79	3.36	21.00	34.06	.62
1171	Beef, neck, boiled	35	58.33	4.50	28.15	12.92	.82
1172	.....do	35	51.71	5.04	31.48	15.45	1.05
1173	Pork, ham, boiled	36	47.11	3.15	19.67	32.83	.73
1174	.....do	36	38.56	2.56	16.02	44.66	.64
1175	.....do	37	44.02	2.95	18.44	36.82	.65
1176	.....do	37	40.41	2.88	17.97	40.64	.56
1181	Veal, leg, boiled	40	64.88	4.51	28.21	5.11	1.05
1182	.....do	40	68.31	4.22	26.40	4.33	.99
1183	Mutton, leg, boiled	41	57.67	4.42	27.60	14.35	1.05
1184	.....do	41	53.95	4.00	25.02	20.69	.79
1187	Beef, round, boiled	42	56.68	4.60	28.78	13.06	1.40
1188	.....do	42	55.71	5.32	33.26	9.70	1.24
1189	Veal, leg, boiled	43	61.82	4.17	26.07	10.23	1.40
1190	.....do	43	61.21	4.27	26.68	10.14	1.25
1191	Pork, ham, boiled	44	39.50	2.21	13.81	43.08	3.54
1192	.....do	44	50.49	3.32	20.72	23.50	4.90
1193	Beef, round, boiled	45	61.85	4.86	30.39	5.81	1.90
1194	.....do	45	60.24	5.02	31.36	6.55	1.41
1203	Beef, round, panbroiled	46	67.03	4.69	29.34	2.42	1.45
1204	Beef, round, sautéd	47	59.84	5.12	32.01	2.42	1.34
1205	Beef, round, boiled	48	66.67	4.96	30.97	1.97	.81
1206	.....do	48	61.96	5.75	35.95	1.65	.75
1211	.....do	51	67.01	4.89	30.54	1.78	.92
1212	.....do	51	60.90	5.55	34.70	3.80	.72
1213	Beef, round, panbroiled	49	69.99	4.30	26.88	2.25	1.26
1214	.....do	49	67.85	4.65	29.05	2.41	1.34
1217	Beef, round, sautéd	50	61.98	4.47	27.92	9.03	1.21
1218	.....do	50	61.78	4.73	29.58	7.44	1.24
1236	Beef, round, panbroiled	52	70.09	4.35	27.21	1.58	1.38
1237	.....do	52	70.20	4.35	27.17	1.60	1.36
1239	Beef, round, sautéd	53	62.91	4.96	30.98	4.90	1.54
1240	.....do	53	61.64	5.06	31.60	5.65	1.59
1242	Beef, round, boiled	54	68.04	4.51	28.21	3.45	.92
1243	.....do	54	64.01	5.16	32.27	3.69	.76
1362	.....do	55	68.54	4.61	28.79	2.11	1.06
1364	Beef, round, gas broiled	56	66.97	4.81	30.09	2.26	1.33

TABLE 1.—*Composition of cooked meats (edible portion)*—Continued.

Laboratory No.	Kind of meat.	Cooking experiment No.	Water.	Nitrogen.	Protein (N×6.25).	Fat.	Ash.
			Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
1365	Beef, round, boiled	57	60.57	5.96	37.25	2.71	0.32
1366	Beef, round, gas broiled	58	47.33	7.92	49.47	3.81	.42
1368	Beef, round, boiled	59	66.60	3.89	24.33	9.33	.58
1369	.....do	60	66.32	3.66	22.85	10.62	.62
1370	.....do	61	54.35	5.05	31.58	14.49	.57
1371	.....do	62	54.08	5.23	32.66	12.70	.60
1376	.....do	63	70.11	4.34	27.12	2.88	.76
1377	.....do	64	67.75	3.72	23.26	8.91	.82
1378	.....do	65	55.94	5.77	36.06	7.90	1.39
1379	.....do	66	58.43	5.25	32.80	8.56	.96
1380	.....do	67	68.30	3.72	23.27	8.50	.50
1381	.....do	68	67.93	3.67	22.96	8.98	.87
1382	.....do	69	55.12	5.27	32.94	12.39	.66
1383	.....do	70	55.73	5.41	34.02	10.75	.75
1384	.....do	71	67.32	4.34	27.12	5.56	.81
1385	.....do	72	64.35	3.86	24.13	11.46	.85
1386	.....do	73	56.13	5.63	35.20	8.99	.69
1387	.....do	74	62.37	4.42	27.65	9.23	.94
1483	Pork, ham, roasted	75	53.37	3.68	23.00	23.38	1.02
1484	.....do	76	50.45	2.68	16.76	31.92	.79
1486	.....do	77	51.46	3.48	21.78	26.51	.88
1489	.....do	78	48.17	3.43	21.42	29.80	.91
1491	.....do	79	41.20	4.66	29.15	29.63	.99
1493	.....do	80	51.61	3.04	18.99	28.78	.87
1504	.....do	81	51.22	3.03	18.95	29.39	.96
1506	.....do	82	49.38	3.78	23.63	26.36	1.08
1511	.....do	83	55.13	3.75	23.44	21.20	1.09
1536	Beef, fifth right rib, roasted	84	40.49	3.16	19.73	39.60	.91
1537	Beef, fourth left rib, roasted	85	47.51	3.23	20.16	32.08	.91
1538	Beef, fifth right rib, roasted	86	32.94	2.52	15.78	51.32	.72
1539	.....do	87	62.89	2.86	17.89	18.34	.80
1540	.....do	88	56.20	3.03	18.95	24.23	.89
1545	Pork, ham, roasted	89	53.62	3.96	24.77	21.04	1.00
1558	.....do	90	56.05	4.24	26.52	17.09	1.08
1559	.....do	91	59.12	3.76	23.47	17.36	1.02
1573	.....do	92	53.57	4.22	26.40	19.73	1.01
1574	.....do	93	55.43	3.92	24.52	19.44	1.05
1575	.....do	94	51.40	4.14	25.88	22.46	.99
1579	.....do	95	51.77	3.74	28.38	19.45	1.08
1587	Beef, fifth right rib, roasted	96	35.12	3.12	19.50	44.92	.79
1588	.....do	97	49.63	3.51	21.95	28.26	.95
1589	.....do	98	28.02	3.51	21.94	49.60	.87
1590	.....do	99	42.45	3.36	20.97	36.85	.82
1614	.....do	100	33.30	2.61	16.34	50.04	.74
1615	.....do	101	45.74	2.92	18.22	35.49	.92
1616	.....do	102	54.83	3.08	19.26	25.16	.97
1629	Beef, rib, roasted	103	44.18	2.81	17.55	37.33	.78
1630	.....do	104	40.85	2.68	16.75	41.57	.80
1631	.....do	105	39.72	3.03	18.98	40.80	.75
1632	.....do	106	39.13	3.21	20.07	39.64	.94

METHODS OF ANALYZING THE BROTHS.

The tables recording the data of the experiments in which meat was cooked in hot water show the quantities of the different ingredients of the resulting broths. The method at present used in analyzing the broths, which differs in some respects from the official methods for analyzing food materials, was practically the same as that described in a previous bulletin of this Office,[a] and is briefly as follows: As soon as the cooked meat was removed from the resulting broth, the latter was rapidly cooled to about 15° C., and strained through a piece of cheese cloth, free from substances soluble in water or ether. This filtration removed the coarser particles of solid matter and most of the fat which was solid at this temperature. The coarse residue and fat

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 102.

thus collected were dried and analyzed, the fat and nitrogen being determined by the usual methods. The small quantity of this material and its character have prevented accurate determinations of the ash in it, but it has been proved by several tests that the amount of ash is very small, and therefore this constituent has not been taken into account in calculating the material making up the losses observed during boiling.

The strained broth which was fairly homogeneous was made up to a definite volume and thoroughly mixed. Portions of 200 cubic centimeters each of this strained broth were filtered in order to determine the amount of undissolved matter still in the broth, and also for the purpose of getting a sample of clear broth. The fine residues, collected on the filters, were dried and analyzed, the fat and nitrogen content being determined by the usual methods. Here again the ash could not be determined, but tests have shown that the quantity was exceedingly small, and it was therefore neglected in the calculations.

The total solids, total nitrogen, proteid nitrogen, and mineral matter were determined in the clear filtered broth. In the experiments here reported the ether extract of the clear broth was not determined, since it was found that the very small amount of substance extracted by ether from the broth was not fat, but consisted of the so-called "organic extractives." The total solids in the clearly filtered broth were determined by evaporating a measured quantity of the broth to dryness upon the water bath, and then drying the residue at a temperature of 100° C. to constant weight. The amount of mineral matter in the clear broth was learned by igniting the solids to a dull-red heat in a platinum dish and completing the analysis in the usual way. The total nitrogen in the clear broth was determined by the Kjeldahl method, and the proteid nitrogen by the bromin method.[a] The nitrogen found in the bromin precipitate was multiplied by the factor 6.25 and the result thus obtained was considered as representing the amount of proteids in the broth. The difference between the proteid nitrogen and the total nitrogen in the broth was taken as nonproteid nitrogen. This latter amount was multiplied by the factor 3.12 and the product was considered as representing the amount of flesh bases present in the broth.

The sum of the proteids, flesh bases, and ash in the clear broth, as determined by the methods given above, was in each case considerably less than the amount of total solids obtained by the direct evaporation of the broth. A similar discrepancy was noticed in our earlier investigations and the difference was designated "other substances."[b] Notwithstanding the fact that in the investigations here reported all the

[a] See U. S. Dept. Agr., Division of Chemistry Bul. 54.

[b] See U. S. Dept. Agr., Office of Experiment Stations Bul. 102, pp. 38, 62, and 63.

determinations of the proteids and flesh bases were carefully made as here outlined, it has been considered more satisfactory, for the time being at least, in calculating the material lost in cooking meats, to combine the flesh bases and the so-called "other substances" under the name of "extractives," a term which is often used in this sense.[a] In the analysis of the broth these extractives are included in the total nitrogenous matter, chiefly for the following reasons: In the first place, these so-called extractives in all probability consist largely of nitrogenous matters. In the second place, in the ordinary analyses of meats, either raw or cooked, these extractives are practically included in the nitrogenous substance (protein) which is generally determined by multiplying the total nitrogen by the factor 6.25. In the third place, if the total nitrogen found in the broths is multiplied by the factor 6.25, as is commonly done in the case of the analysis of meats, a value is obtained which, as a rule, agrees closely with that for "extractives" obtained by adding the flesh bases and the "other substances."

COMPOSITION OF THE BROTHS OBTAINED WHEN MEAT WAS COOKED IN HOT WATER.

The composition of the clear filtered broths and the solid matter in the fine and coarse residues in the broths obtained in the boiling experiments is given in Table 2. This table gives the total weights of the ingredients found first in the clear broth and second in the suspended or dissolved matter in the broth. For example, the clear-filtered broth from meat (laboratory No. 1027) in experiment No. 19, contained 2.78 grams of protein precipitated by bromin and 34.32 grams of extractives, equal to 37.10 grams of total nitrogenous matter. This clear broth also contained 11.62 grams of ash, and the total nutrients in the entire broth were equal to 48.82 grams. The suspended or insoluble matter removed by filtering the original complete broth consisted of 1.35 grams of protein and 10.19 grams of fat, making a total of 11.54 grams.

[a] See Mitchell's Flesh Foods, pp. 7, 45, and 48. See also Allen's Commercial Organic Analysis, vol. 4, Philadelphia, 1898, pp. 270 and 335, and Halliburton's Text-book of Chemical Physiology and Pathology, 1891, p. 418.

TABLE 2.—*Composition of the clear filtered broths and the solid matter in the broths.*

Broth from meat, laboratory No.	Experiment No.	Total weights of nutrients in clear broth.					Composition of solid matter in broth.		
		Protein precipitated by bromin.	Extractives by difference.	Total nitrogenous matter.	Ash.	Total nutrients.	Protein.	Fat.	Total.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
1027	19	2.78	34.32	37.10	11.62	48.82	1.35	10.19	11.54
1097	19	1.46	17.56	19.02	5.43	24.45	1.00	2.88	3.88
1091	26	1.44	19.14	20.58	6.32	26.90	.57	11.74	12.31
1092	26	1.93	16.19	18.12	5.38	23.50	.44	9.53	9.97
1093	27	1.68	12.49	14.17	4.29	18.46	1.67	17.86	19.53
1094	27	1.09	11.33	12.42	3.39	15.81	.91	25.91	26.82
1095	28	1.47	21.63	23.10	7.46	30.56	.97	20.37	21.34
1096	28	1.89	19.99	21.88	6.63	28.51	.59	20.19	20.78
1098	29	1.99	16.30	18.29	4.99	23.28	.33	31.71	32.04
1099	29	2.79	22.09	24.88	6.83	31.71	2.17	30.75	32.92
1169	34	2.09	14.89	16.98	4.49	21.47	.77	51.97	52.74
1170	34	2.19	13.11	15.30	4.01	19.31	.45	55.70	56.15
1171	35	1.26	14.65	15.91	5.23	21.14	1.29	7.06	8.35
1172	35	1.22	15.92	17.14	5.21	22.35	.59	14.75	15.34
1173	36	1.95	12.29	14.24	4.00	18.24	.73	8.49	9.22
1174	36	.98	13.03	14.01	3.83	17.83	.65	72.81	73.46
1175	37	.85	14.24	15.09	4.88	19.97	.21	26.77	26.98
1176	37	.96	16.12	17.08	5.55	22.63	.51	38.42	38.93
1181	40	5.71	21.24	26.95	6.31	33.26	.91	2.39	3.30
1182	40	6.67	18.01	24.68	5.89	30.56	1.50	1.17	2.67
1183	41	1.03	12.00	13.03	3.52	16.54	.30	41.10	41.40
1184	41	1.75	14.24	15.99	4.23	20.22	.68	88.14	88.82
1187	42	1.73	10.21	11.94	.....	.....	3.57	12.24	15.81
1188	42	2.33	14.23	16.56	.....	.....	1.51	36.09	37.60
1189	43	3.78	8.75	12.53	.....	.....	.33	3.49	3.82
1190	43	4.38	9.18	13.56	.....	.....	.25	3.11	3.36
1191	44	1.61	4.74	6.35	.....	.....	.52	56.27	56.79
1192	44	2.05	3.91	5.96	.....	.....	.72	12.95	13.67
1193	45	2.50	8.23	10.73	.....	.....	3.31	11.36	14.67
1194	45	1.65	9.35	11.00	.....	.....	2.42	9.68	12.10
1205	48	.97	16.10	17.07	5.55	22.61	.65	.75	1.40
1206	48	1.09	22.09	23.19	7.21	30.40	.48	.63	1.11
1211	51	3.09	23.68	26.77	8.59	35.37	.75	.65	1.40
1212	51	2.51	22.87	25.38	8.44	33.82	1.15	4.86	6.01
1242	54	2.25	18.56	20.81	7.21	28.02	1.48	1.50	2.98
1243	54	1.70	14.14	15.84	5.33	21.17	.84	2.69	3.53
1368	59	1.08	9.08	10.16	3.07	13.24	1.52	.78	2.30
1369	60	7.67	33.98	41.65	12.34	53.99	14.43	3.99	18.42
1370	61	.99	9.35	10.34	3.35	13.68	1.72	6.30	8.03
1371	62	2.58	45.27	47.87	15.38	63.22	10.60	33.13	43.73
1376	63	2.57	6.25	8.82	2.86	11.67	1.33	.26	1.59
1377	64	7.80	25.62	33.42	9.48	42.90	6.69	3.05	9.74
1378	65	.47	7.92	8.39	3.23	11.62	.21	5.52	5.73
1379	66	2.72	36.11	38.83	10.47	49.30	3.96	15.70	19.66
1380	67	.89	3.50	4.39	3.27	7.65	5.11	.97	6.08
1381	68	9.38	38.18	47.55	11.80	59.36	11.01	3.66	14.67
1382	69	.30	10.25	10.55	3.21	13.76	.46	4.01	4.47
1383	70	1.44	48.23	49.67	15.35	64.92	17.10	22.17	39.28
1384	71	2.23	7.48	9.71	2.43	12.14	3.49	.43	2.92
1385	72	4.89	22.28	27.17	7.82	34.83	11.19	4.97	16.17
1386	73	.29	8.84	9.13	3.35	12.49	1.78	3.03	4.81
1387	74	3.16	24.77	27.93	9.15	37.09	8.66	4.60	13.26

In Table 3, which follows, the weights of nutrients in the complete original broths are given. For example, the entire broth from meat (laboratory No. 1027) in experiment No. 19, which resulted in cooking 2,141.25 grams of meat, contained 4.13 grams of protein and 34.32 grams of extractives, making a total of 38.45 grams of nitrogenous matter. This original broth also contained 10.19 grams of fat and 11.62 grams of ash, which makes a total of 60.26 grams of nutrients in the entire broth produced in cooking the beef by the method outlined in the description of this experiment on pages 18–20 of this bulletin.

TABLE 3.—*Composition of the original, complete broths.*

Broth from meat, laboratory No.	Experiment No.	Weight of meat taken.	Total weights of nutrients in original broth.					
			Protein precipitated by bromin.	Extractives by difference.	Total nitrogenous matter.	Fat.	Ash.	Total nutrients.
		Grams.	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
1027	19	2,141.25	4.13	34.32	38.45	10.19	11.62	60.26
1097	19	1,139.48	2.46	17.56	20.02	2.88	5.43	28.33
1091	26	1,383.07	2.01	19.14	21.15	11.74	6.32	39.21
1092	26	1,409.64	2.37	16.19	18.56	9.53	5.38	33.47
1093	27	2,120.13	3.25	12.49	15.84	17.86	4.29	37.99
1094	27	2,193.89	2.00	11.33	13.33	25.91	3.39	42.63
1095	28	1,211.75	2.44	21.63	24.07	20.37	7.46	51.90
1096	28	1,152.63	2.48	19.99	22.47	20.19	6.63	49.29
1098	29	1,017.05	2.32	16.30	18.61	31.71	4.99	55.31
1099	29	1,740.51	4.96	22.09	27.05	30.75	6.83	64.63
1169	34	1,806.37	2.86	14.89	17.75	51.97	4.49	74.21
1170	34	1,923.58	2.64	13.11	15.75	55.70	4.01	75.46
1171	35	1,523.68	2.55	14.65	17.20	7.06	5.23	29.49
1172	35	1,764.97	1.81	15.92	17.73	14.75	5.21	37.69
1173	36	1,838.38	2.68	12.29	14.97	8.49	4.00	27.46
1174	36	1,608.50	1.63	13.03	14.66	72.81	3.83	91.29
1175	37	1,882.66	1.06	14.24	15.30	26.77	4.88	46.95
1176	37	2,016.70	1.47	16.12	17.59	38.42	5.55	61.56
1181	40	1,648.31	6.62	21.24	27.86	2.39	6.31	36.56
1182	40	1,939.09	8.17	18.01	26.18	1.17	5.89	33.24
1183	41	912.82	1.33	12.00	13.33	41.10	3.52	57.96
1184	41	1,268.14	2.43	14.24	16.67	88.14	4.23	109.04
1187	42	1,945.56	5.30	10.21	15.51	12.24	.....	27.75
1188	42	2,190.12	3.84	14.23	18.07	36.09	.....	54.16
1189	43	1,835.07	4.11	8.75	12.86	3.49	.....	16.35
1190	43	1,988.38	4.63	9.18	13.81	3.11	.....	16.92
1191	44	1,410.44	2.13	4.74	6.87	56?27	.....	63.14
1192	44	1,663.98	2.77	3.91	6.68	12.95	.....	19.63
1193	45	1,529.64	5.81	8.23	14.04	11.36	.....	25.40
1194	45	1,615.56	4.07	9.35	13.42	9.68	.....	23.10
1205	48	1,237.90	1.62	16.10	17.72	.75	5.55	24.02
1206	48	1,210.15	1.57	22.09	23.66	.63	7.21	31.50
1211	51	2,141.09	3.84	23.68	27.52	.65	8.59	36.76
1212	51	1,529.94	3.66	22.87	26.53	4.86	8.44	39.83
1242	54	2,108.62	3.73	18.56	22.29	1.50	7.21	31.00
1243	54	1,128.00	2.54	14.14	16.68	2.69	5.33	24.70
1368	59	500.00	2.60	9.08	11.68	.78	3.07	15.53
1369	60	2,500.00	22.10	33.99	56.09	3.99	12.34	72.42
1370	61	500.00	2.72	9.34	12.06	6.30	3.35	21.71
1371	62	2,500.00	13.18	45.27	58.45	33.13	15.38	106.96
1376	63	520.77	3.90	6.24	10.14	.26	2.86	13.26
1377	64	2,384.54	14.49	25.62	40.11	3.05	9.48	52.64
1378	65	501.41	.68	7.92	8.60	5.52	3.23	17.35
1379	66	2,502.55	6.68	36.11	42.79	15.70	10.47	68.96
1380	67	500.00	6.00	3.50	9.50	.97	3.27	13.74
1381	68	2,500.00	20.39	38.18	58.57	3.66	11.80	74.03
1382	69	500.00	.76	10.25	11.01	4.01	3.21	18.23
1383	70	2,500.00	18.55	48.23	66.78	22.17	15.35	104.30
1384	71	500.00	4.72	7.48	12.20	.43	2.43	15.06
1385	72	2,500.00	16.09	22.28	38.37	4.97	7.82	51.16
1386	73	500.00	2.06	8.84	10.90	3.03	3.35	17.28
1387	74	2,500.00	11.82	24.77	36.59	4.60	9.15	50.34

METHODS OF ANALYZING THE DRIPPINGS.

The composition of the drippings obtained in roasting the meats is reported in the tables giving the data of the individual experiments. The drippings were carefully weighed and kept in a dry place at about 60° C. for two or three hours until the solid matter suspended in the fat had entirely settled. As much as possible of the supernatant fat was poured off and the remainder was filtered, dry, warm filter paper being used, and the operation being carried out in a large water oven kept at a suitable temperature. The water, nitrogen, and mineral matter in the filtered fat were determined in a number of the experi-

ments, and in no case were appreciable quantities of these constituents found, although frequently the fat was more or less changed in color.

The solid residue from the drippings remaining in the beaker and upon the filter was cooled and then washed several times with ether to remove the fat still adhering to it and was finally treated with hot water, which dissolved the greater portion of it. The nitrogen in the residue insoluble in water was determined by the Kjeldahl method, the amount multiplied by the factor 6.25 being assumed to represent the total proteids in this portion of the drippings. The aqueous solution of the solid material of the drippings was diluted to a definite volume and analyzed by the method used with the clear filtered broth (see above). That is to say, the total solids, total nitrogen, proteid nitrogen, and mineral matters were determined. The material designated "extractives," as in the case of the clear broth, represents the flesh bases, together with other substances the nature of which at present is not well understood.

The sum of the proteids insoluble in water and the water-soluble constituents of the drippings, i. e., total nitrogenous matter, and the mineral matters are subtracted from the original weight of the drippings, the difference being assumed to represent the amount of fat in the drippings. This assumption is not believed to be entirely correct, since it is quite probable that the solid residue, other than fat, contains a small amount of water. That the quantity of water in the drippings is quite small, as a rule, seems certain, but as yet we have not been able to determine satisfactorily the exact amount, on account of the very large amount of fat occurring in the drippings and the comparatively small amount of other substances present.

COMPOSITION OF THE DRIPPINGS FROM ROASTING EXPERIMENTS.

The composition of the drippings obtained during the roasting of the meats is given in Table 4, which shows the quantity of each ingredient, expressed by weight.

TABLE 4.—*Chemical composition of drippings from roasting experiments.*

Drippings from meat, laboratory No.	Experiment No.	Weight of meat taken.	Water-insoluble matter.		Water-soluble matter.				Total nutrients.
			Fat.	Protein.	Protein precipitated by bromin.	Extractives by difference.	Total nitrogenous matter.	Ash.	
		Grams.	*Grams.*	*Gram.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
1483	75	4,124.84	312.37	.....	3.43	7.05	10.48	3.18	326.03
1484	76	3,642.90	286.01	.....	2.75	6.34	9.09	2.58	297.68
1486	77	4,060.06	478.25	.....	3.42	10.59	14.01	3.86	496.12
1489	78	3,940.57	548.11	.....	2.36	12.13	14.49	4.39	566.99
1491	79	3,742.12	683.70	.....	4.35	9.55	13.90	4.05	701.65
1493	80	1,842.71	159.01	.....	.27	2.88	3.15	.85	163.01
1504	81	4,266.59	517.97	.....	1.80	2.87	4.67	1.83	524.47
1506	82	4,052.97	474.53	.....	5.64	10.85	16.49	5.10	496.12
1511	83	3,961.83	488.33	0.22	5.73	5.20	10.93	3.72	503.20
1536	84	1,895.84	181.98	.09	.57	.93	1.50	.71	184.28
1537	85	2,112.04	128.66	.13	.13	1.51	1.64	.67	131.10
1538	86	1,963.20	243.74	.04	.07	.41	.48	.24	244.50
1539	87	1,856.89	150.99	.04	.18	.73	.91	.43	152.37
1540	88	1,856.89	100.99	.07	.19	.99	1.18	.51	102.75
1545	89	4,706.00	421.93	.84	14.83	17.42	32.25	9.19	464.21
1558	90	6,013.61	599.86	.02	8.22	17.32	25.54	8.89	634.31
1559	91	4,294.94	354.49	.92	8.10	7.58	15.68	4.55	375.64
1573	92	4,344.55	425.70	.38	7.19	24.73	31.92	9.77	467.77
1574	93	4,932.80	511.04	.97	4.53	18.60	23.13	7.04	542.18
1575	94	4,153.19	570.98	.41	3.53	20.22	23.75	7.29	602.43
1579	95	4,351.64	554.33	.31	6.27	16.88	22.65	7.40	584.69
1587	96	2,445.14	334.99	.26	.98	8.10	9.08	2.96	347.29
1588	97	1,771.85	212.07	.06	.85	1.98	2.83	1.19	216.15
1589	98	2,310.48	403.03	.13	.84	2.19	3.03	1.33	407.52
1590	99	1,601.75	92.04	.11	.39	2.18	2.57	.95	95.67
1614	100	2,997.95	229.66	.22	.49	2.28	2.77	1.24	233.89
1615	101	2,197.09	118.82	.06	.18	.91	1.09	.52	120.49
1616	102	1,367.86	12.77	.20	.08	.78	.86	.35	14.18
1629[a]	103	1,474.17	76.72	.14	.23	2.90	3.13	4.10	83.86
1630[a]	104	1,321.78	80.55	.32	.18	2.97	3.15	4.21	88.05
1631[a]	105	1,346.59	117.15	.40	.52	6.30	6.82	7.76	131.61
1632	106	1,353.68	159.91	.03	.22	2.37	2.59	4.22	166.53

[a] The drippings from laboratory No. 1629 contained 18.89 grams of water; from laboratory No. 1630, 14.70 grams of water, and from laboratory No. 1631, 52.67 grams of water.

METHODS OF DETERMINING THE WATER-SOLUBLE CONSTITUENTS OF MEATS.

As the investigation progressed it seemed desirable, in some cases, to determine quantitatively the water-soluble constituents of raw and cooked meats. The methods used were, briefly, as follows: A sample, weighing 10 grams, of fresh meat, either raw or cooked—that is, meat which had not been air dried—was repeatedly extracted with cold water in portions of 50 cubic centimeters, the extraction being continued until 10 cubic centimeters of the extract contained not more than 1 milligram of total solids. It was usually found that 500 cubic centimeters of water was sufficient to complete the operation. The extract was made up to a definite volume, and the total solids, ash, total nitrogen, proteid nitrogen, and extractives were determined by the methods given above for the analysis of the clear-filtered broth (see p. 11).

In the case of the air-dried samples of the meats, the method of extraction with water was as follows: A portion, weighing 5 grams, was treated several times with ether, to remove the greater part of the fat present, and then extracted repeatedly with cold distilled water as above. The aqueous extract was then made up to a definite volume and analyzed as indicated.

EXPERIMENTS WITH MEATS COOKED BY BOILING.

The development of the experimental methods for determining the losses and changes which result in cooking meats by boiling is given in full in a previous publication of this Office.[a] It is, perhaps, sufficient to say in this connection that it was found that in cooking meat in hot or in boiling water there was no appreciable loss of nutritive material by volatilization, but that all the nutrients removed from the meat by this method of cooking passed into the resulting broth. In reporting these experiments all material separated from the meat during the cooking, whether mechanically or by solution, has been designated "loss" by cooking. The material thus removed, however, is not necessarily an actual loss from the standpoint of household economy if the broth is used as soup or in any other way as food.

In each cooking experiment the meat was weighed before and after cooking, and the difference was taken as representing the total loss in weight, resulting from the process of cooking. The material lost consisted partly of water and partly of nutritive ingredients contained in the broth. The broth was analyzed by the methods given above (see p. 11), the protein, fat, and mineral matters being determined. The total loss in weight less the sum of these ingredients in the broth was assumed to represent the amount of water removed from the meat in cooking. The cooked meat was then analyzed and the amount of each nutrient in the cooked meat was added to that in the broth and the sum taken as the amount of the nutrients in the raw meat. From this amount, and the amount in the broth, the percentage loss of each ingredient was calculated.

In this connection it should be noted that, strictly speaking, the sum of the constituents in the cooked meat and in the broth as found by the usual analyses may not represent exactly the original composition of the meat, since during the cooking there may be more or less cleavage of proteid material into simpler nitrogenous compounds. If such cleavage does actually take place it would be an error to assume that all the nitrogenous bodies found in the broth are contained in the meat in the same form. However, with our present knowledge of the subject the method followed seems the most satisfactory procedure.

The calculation and interpretation of the results of the experiments may be illustrated by the following examples: In experiment No. 19 (p. 20) the weight of meat before cooking, in the first test, was 2,142.25 grams. The weight of the cooked meat was 1,216.64 grams. The total loss in weight was therefore 924.61 grams, which is equivalent to a loss of 43.18 per cent of the weight of the original meat.

The composition of the edible portion of the cooked meat, as shown by Table 1, was 58.16 per cent water, 32.61 per cent protein, 8.38 per

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 102.

cent fat, and 0.96 per cent ash. In Table 5 (p. 21), giving the final results of cooking experiment No. 19, it will be noticed that the total nutrients in the cooked meat are water 707.72 grams, nitrogenous matter 396.72 grams, fat 101.95 grams, and ash 11.68 grams. The entire amount of water in the cooked meat was found by multiplying the weight of the cooked meat (1,216.64 grams) by the percentage of water (58.16) found in the cooked meat, which gave 707.72 grams. By similar calculations the weight of protein, fat, and mineral matter (ash) in the entire cooked meat was obtained.

In the next line of Table 5, there is given the weight of nutrients in the broth resulting from the cooking of meat, No. 1027. These values, with the exception of the data for water, were obtained by the analysis of the original complete broth (see Table 3, p. 15). Referring to this table, it will be seen that the broth from meat No. 1027, cooking experiment No. 19, contained 38.45 grams of nitrogenous matter, 10.19 grams of fat, and 11.62 grams of mineral matter. The sum of these three quantities, 60.26 grams, represents the total nutrients in the entire broth. This quantity subtracted from 924.61 grams, the total loss in weight resulting in cooking, gives 864.45 grams, the amount of water removed from the meat during the cooking.

In the third line of Table 5, which gives the results of cooking experiment No. 19, there is given the weights of the nutrients in the uncooked meats. These data are obtained by adding the weight of each nutrient in the cooked meat to the weight of each nutrient found in the broth. The uncooked meat (No. 1027a), weighing 2,142.25 grams, therefore contained 1,572.17 grams of water, 435.17 grams of nitrogenous matter, 112.14 grams of fat, and 23.30 grams of ash.

The tabulated statement of each experiment represents the amount of each nutrient remaining in the cooked meat and the amount of each nutrient found in the resulting broth, expressed in percentages of the total weight of each nutrient which the original meat contained. Thus in experiment No. 19 the weight of water (707.72 grams) found in the cooked meat was divided by the total weight of water (1,572.17 grams) contained in the uncooked meat and then multiplied by 100, which gave the percentage of water (45.02) originally contained in the uncooked meat which still remained in the cooked meat. In the same way the percentage of water contained in the broth or removed during the cooking was obtained by dividing the weight of water (864.45 grams) found in the broth by the total weight of water (1,572.17 grams) contained in the uncooked meat and then multiplying by 100.

Similar calculations serve to show the percentage of nitrogenous matter, fat, and ash remaining in the uncooked meat and the percentage of nitrogenous matter, fat, and ash which entered the broth during the cooking. In the first test of experiment No. 19 the following percentages of nutrients of the original uncooked meat were found in

the cooked product: Water, 45.02; nitrogenous matter, 91.16; fat, 90.91, and ash, 50.13. The broth in the same test contained the following percentages of the nutrients of the original uncooked meat: Water, 54.98; nitrogenous matter, 8.84; fat, 9.09, and ash, 49.87.

Finally, the table of data for each experiment gives the percentage amount of each nutrient in the broth referred to the entire weight of the uncooked meat. Again referring to experiment No. 19, in Table 5, the last row of numbers for the first test gives this data. For example, the weight of water (864.45 grams) in the broth divided by the weight of the uncooked meat (2,142.25 grams) and this quotient multiplied by 100 gives the percentage of water (40.37) which is removed by cooking referred to the original meat. In the same manner, by dividing the weight of nitrogenous matter (8.84 grams) in the broth by the weight of the uncooked meat (2,142.25 grams) and multiplying this quotient by 100, the number 1.80 is obtained, which represents the percentage amount of nitrogenous matter in the broth referred to the weight of the uncooked meat.

The results of the individual cooking experiments are given below, in every case the object of the experiment, the kind and amount of meat used, and the method and time of cooking being recorded in detail. Preceding the tabular statement of the details of each experiment is a paragraph giving the weight of cooked meat and the actual and percentage loss of weight resulting from the cooking.

The details of the experiments, showing the kinds and amounts of losses sustained when meat was cooked in hot water under various conditions, are recorded in Tables 5–38.

COOKING EXPERIMENT NO. 19.

The object of this experiment, which includes two tests, was to determine the amount of the constituents of moderately fat beef round which entered the broth when pieces of different sizes were cooked. In each case the meat was plunged immediately into boiling distilled water. The water was kept as near boiling as possible for ten minutes, then gradually reduced to from 80° to 85° C., and maintained at this temperature for two hours.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	2,142.25
Weight of meat after cooking	do	1,216.64
Loss in weight in cooking	do	924.61
Loss in weight in cooking	per cent	43.18
Second test:		
Weight of meat before cooking	grams	1,139.48
Weight of meat after cooking	do	682.01
Loss in weight in cooking	do	457.47
Loss in weight in cooking	per cent	40.15

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 5.—*Results of cooking (boiling) experiment No. 19.*

	Laboratory No.	First test. Water.	Protein.	Fat.	Ash.	Laboratory No.	Second test. Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1027	707.72	396.72	101.95	11.68	1097	388.34	214.49	71.81	6.41
In broth	1027	864.45	38.45	10.19	11.62	1097	429.15	20.02	2.88	5.43
In uncooked meat	1027a	1,572.17	435.17	112.14	23.30	1097a	817.49	234.51	74.69	11.84
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	1027	45.02	91.16	90.91	50.13	1097	47.50	91.46	96.15	54.14
In broth	1027	54.98	8.84	9.09	49.87	1097	52.50	8.54	3.85	45.86
In broth on basis of total weight of uncooked meat	1027a	40.37	1.80	.48	.54	1097a	37.66	1.76	.25	.48

COOKING EXPERIMENT NO. 26.

In this experiment, which was made to ascertain what proportion of the constituents of fat meat entered the broth during cooking, there were two tests with fat cuts of beef round of the sort which can be ordinarily obtained from local meat markets. Each piece of meat was plunged into 2,000 cubic centimeters of boiling water, kept at this temperature for ten minutes, and the cooking then continued for two hours at a temperature varying from 80° to 85° C.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	1,383.07
Weight of meat after cooking	do	875.22
Loss in weight in cooking	do	507.85
Loss in weight in cooking	per cent	36.72
Second test:		
Weight of meat before cooking	grams	1,409.64
Weight of meat after cooking	do	958.85
Loss in weight in cooking	do	450.79
Loss in weight in cooking	per cent	31.98

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 6.—*Results of cooking (boiling) experiment No. 26.*

	Laboratory No.	First test. Water.	Protein.	Fat.	Ash.	Laboratory No.	Second test. Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1091	494.06	265.54	112.38	7.88	1092	557.96	275.58	121.49	9.01
In broth	1091	468.64	21.15	11.74	6.32	1092	417.32	18.56	9.53	5.38
In uncooked meat	1091a	962.70	286.69	124.12	14.20	1092a	975.28	294.14	131.02	14.39
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	1091	51.32	92.62	90.54	55.49	1092	57.21	93.69	92.73	62.61
In broth	1091	48.68	7.38	9.46	44.51	1092	42.79	6.31	7.27	37.39
In broth on basis of total weight of uncooked meat	1091a	33.88	1.53	.85	.46	1092a	29.60	1.32	.68	.38

COOKING EXPERIMENT NO. 27.

The object of this experiment was to ascertain what proportion of the constituents of very fat meat entered the broth during cooking. Tests were made with two cuts of beef (i. e., a large piece of beef divided into two parts) of what is known locally as "plate boil," containing about the same proportion of fat as similar cuts commonly sold in the local markets. In cooking, each piece was plunged into boiling distilled water, which was kept as near the boiling point as possible for ten minutes. The cooking was then continued for two hours at a temperature of 80° to 85° C. The meat was tough and rare, or underdone.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	2,120.13
Weight of meat after cooking	do	1,776.13
Loss in weight in cooking	do	344.00
Loss in weight in cooking	per cent	16.23
Second test:		
Weight of meat before cooking	grams	2,193.89
Weight of meat after cooking	do	1,961.17
Loss in weight in cooking	do	232.72
Loss in weight in cooking	per cent	10.61

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth:

TABLE 7.—*Results of cooking (boiling) experiment No. 27.*

	First test.				Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1093	806.53	387.02	574.04	12.08	1094	862.92	396.55	696.33	13.53
In broth	1093	306.01	15.84	17.86	4.29	1094	190.10	13.32	25.91	3.39
In uncooked meat	1093a	1,112.54	402.86	591.90	16.37	1094a	1,053.02	409.87	722.24	16.92
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	72.49	96.07	96.98	73.79	.....	81.95	96.75	96.41	79.96
In broth	.....	27.51	3.93	3.02	26.21	.....	18.05	3.25	3.59	20.04
In broth on basis of total weight of uncooked meat	.....	14.43	.74	.84	.20	.....	8.67	.61	1.18	.15

COOKING EXPERIMENT NO. 28.

The object of this experiment, which was divided into two tests, was to learn the kind and amount of constituents which entered the broth when the meat was cooked continuously for two hours in water which was boiling vigorously. In each test medium lean beef round was used, the meat being plunged into boiling distilled water just sufficient in amount to cover the meat, and the cooking continued at that temperature for two hours. At the end of this period the meat was tender and thoroughly cooked, but was quite tasteless.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	1,211.75
Weight of meat after cooking	do	663.52
Loss in weight in cooking	do	548.23
Loss in weight in cooking	per cent	45.24
Second test:		
Weight of meat before cooking	grams	1,152.63
Weight of meat after cooking	do	616.80
Loss in weight in cooking	do	535.83
Loss in weight in cooking	per cent	46.49

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 8.—*Results of cooking (boiling) experiment No. 28.*

	First test.				Second test.			
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1095	340.38	265.81	48.24	7.17	1096	317.65	246.41	49.04	5.74
In broth	1095	496.33	24.07	20.37	7.46	1096	486.53	22.47	20.19	6.63
In uncooked meat	1095a	836.71	289.88	68.61	14.63	1096a	804.18	268.88	69.23	12.37
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	40.68	91.70	70.31	49.00	.....	39.50	91.64	70.84	46.40
In broth	.....	59.32	8.30	29.69	51.00	.....	60.50	8.36	29.16	53.60
In broth on basis of total weight of uncooked meat	.....	40.96	1.99	1.68	.62	.....	42.21	1.95	1.75	.58

COOKING EXPERIMENT NO. 29.

This experiment, which included two tests, was undertaken to determine what constituents of medium fat beef entered the broth when meat was cooked at a temperature lower than boiling. Moderately fat beef round was used, each piece being placed in separate portions of distilled water, 80° to 85° C., and cooked at this temperature for three hours.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	1,017.05
Weight of meat after cooking	do	565.42
Loss in weight in cooking	do	451.63
Loss in weight in cooking	per cent	44.41
Second test:		
Weight of meat before cooking	grams	1,740.51
Weight of meat after cooking	do	1,102.11
Loss in weight in cooking	do	638.40
Loss in weight in cooking	per cent	36.68

The amounts and proportions of nutrients in the cooked meat and broth are shown in the following table:

TABLE 9.—*Results of cooking (boiling) experiment No. 29.*

	Laboratory No.	First test. Water.	Protein.	Fat.	Ash.	Laboratory No.	Second test. Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1098	305.16	185.63	70.91	5.26	1099	596.24	296.36	200.36	10.03
In broth	1098	396.31	18.61	31.71	4.99	1099	573.78	27.05	30.75	6.83
In uncooked meat	1098a	701.47	204.24	102.62	10.25	1099a	1,170.02	323.41	231.11	16.86
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	------	43.50	90.89	69.10	51.32	------	50.96	91.66	86.69	59.49
In broth	------	56.50	9.11	30.90	48.68	------	49.04	8.34	13.31	40.51
In broth on basis of total weight of uncooked meat	------	38.97	1.83	3.12	.49	------	32.97	1.56	1.77	.39

COOKING EXPERIMENT NO. 34.

The object of this experiment was to determine what constituents of the cut, known as rolled rib of beef, entered the broth when cooked at a temperature lower than that of boiling. The cut selected was divided into two equal parts, each of which was plunged into boiling distilled water. This temperature was maintained for ten minutes, then allowed to drop to 85° C., and the cooking continued for three hours.

The losses in weight during cooking were as follows:

First test:

Weight of meat before cooking	grams	1,806.37
Weight of meat after cooking	do	1,326.90
Loss in weight in cooking	do	479.47
Loss in weight in cooking	per cent	26.54

Second test:

Weight of meat before cooking	grams	1,923.58
Weight of meat after cooking	do	1,530.35
Loss in weight in cooking	do	393.23
Loss in weight in cooking	per cent	20.44

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 10.—*Results of cooking (boiling) experiment No. 34.*

	Laboratory No.	First test. Water.	Protein.	Fat.	Ash.	Laboratory No.	Second test. Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1169	686.01	291.79	345.53	8.23	1170	685.44	321.37	521.23	9.49
In broth	1169	405.25	17.75	51.97	4.49	1170	317.77	15.75	55.70	4.01
In uncooked meat	1169a	1,091.26	309.54	397.50	12.72	1170a	1,003.21	337.12	576.93	13.50
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	------	62.86	94.27	86.93	64.70	------	68.32	95.33	90.35	70.30
In broth	------	37.14	5.73	13.07	35.30	------	31.68	4.67	9.65	29.70
In broth on basis of total weight of uncooked meat	------	22.43	.98	2.88	.25	------	16.52	.82	2.90	.21

COOKING EXPERIMENT NO. 35.

The object of this experiment, which included two tests, was to study the effect of different methods of cooking upon the kind and amount of constituents which passed into the broth. The piece of lean beef selected was divided into two nearly equal parts, one of which was placed in cold water and allowed to stand for thirty minutes. The water was then heated gradually for an hour, reaching 60° C. The cooking continued at this temperature for four hours longer. The second piece was plunged into boiling water, the temperature being maintained as near this point as possible for ten minutes and then allowed to drop to 85° C., and the cooking continued for three hours longer at from 80° to 85° C.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	1,523.68
Weight of meat after cooking	do	1,098.33
Loss in weight in cooking	do	425.35
Loss in weight in cooking	per cent	27.92
Second test:		
Weight of meat before cooking	grams	1,764.97
Weight of meat after cooking	do	1,296.27
Loss in weight in cooking	do	468.70
Loss in weight in cooking	per cent	26.56

The amounts and proportions of the nutrients of the cooked meat and broth are shown in the following table:

TABLE 11.—*Results of cooking (boiling) experiment No. 35.*

	First test.					Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients.		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1171	640.65	309.18	141.90	9.61	1172	670.30	408.06	200.28	13.61
In broth	1171	395.86	17.20	7.06	5.23	1172	431.01	17.73	14.75	5.21
In uncooked meat	1171a	1,036.51	326.38	148.96	14.24	1172a	1,101.31	425.79	215.03	18.82
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	61.77	94.73	95.26	63.27	.....	60.86	95.84	93.14	72.32
In broth	.....	38.23	5.27	4.74	36.73	.....	39.14	4.16	6.86	27.68
In broth on basis of total weight of uncooked meat	.....	25.98	1.13	.46	.34	.....	24.42	1.00	.84	.30

COOKING EXPERIMENT NO. 36.

The object of this experiment, which included two tests, was to study the kind and amount of nutrients of uncured ham which passed into the water during cooking. Each of the two pieces of ham used was plunged into boiling water, which was kept as near this temperature as possible for ten minutes and then allowed to cool to 85° C., and the cooking continued for three hours at from 80° to 85° C.

The losses in weight during cooking were as follows:

First test:

Weight of meat before cooking	grams	1,838.48
Weight of meat after cooking	do	1,462.85
Loss in weight in cooking	do	375.63
Loss in weight in cooking	per cent	20.43

Second test:

Weight of meat before cooking	grams	1,608.50
Weight of meat after cooking	do	1,154.83
Loss in weight in cooking	do	453.67
Loss in weight in cooking	per cent	28.20

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 12.—*Results of cooking (boiling) experiment No. 36.*

	Laboratory No.	First test. Water.	Protein.	Fat.	Ash.	Laboratory No.	Second test. Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1173	689.14	287.74	480.26	10.68	1174	445.31	185.01	515.75	7.39
In broth	1173	348.17	14.97	8.49	4.00	1174	362.38	14.66	72.81	3.83
In uncooked meat	1173a	1,037.31	302.71	488.75	14.68	1174a	807.69	199.67	588.56	11.22
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	66.44	95.06	98.26	72.75	.....	55.13	92.66	87.63	65.86
In broth	.....	33.56	4.94	1.74	27.25	.....	44.87	7.34	12.37	34.14
In broth on basis of total weight of uncooked meat	.....	18.94	.81	.46	.22	.....	22.53	.91	4.53	.24

COOKING EXPERIMENT NO. 37.

The object of this experiment was to determine the kind and amount of losses which resulted when uncured ham was cooked by boiling. The method followed was the same as in experiment No. 36.

The losses in weight during cooking were as follows:

First test:

Weight of meat before cooking	grams	1,882.66
Weight of meat after cooking	do	1,480.99
Loss in weight in cooking	do	401.67
Loss in weight in cooking	per cent	21.33

Second test:

Weight of meat before cooking	grams	2,016.70
Weight of meat after cooking	do	1,452.89
Loss in weight in cooking	do	563.81
Loss in weight in cooking	per cent	27.95

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 13.—*Results of cooking (boiling) experiment No. 37.*

	First test.				Second test.			
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1175	651.94	273.10	545.30	9.63	1176	587.13	261.09	590.46	8.14
In broth	1175	354.72	15.30	26.77	4.88	1176	502.25	17.59	38.42	5.55
In uncooked meat	1175a	1,000.66	288.40	572.07	14.51	1176a	1,089.38	278.68	628.88	13.69
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	64.55	94.69	95.32	66.37	.....	53.90	93.69	93.89	59.46
In broth	.....	35.45	5.31	4.68	33.63	.....	46.10	6.31	6.11	40.54
In broth on basis of total weight of uncooked meat	.....	18.84	.82	1.42	.26	.....	24.90	.88	1.91	.28

COOKING EXPERIMENT NO. 40.

The object of this experiment, which included two tests, was to ascertain the kind and amount of nutrients which passed into the broth when veal was cooked. Each of the pieces of veal leg used was plunged into boiling water. This temperature was maintained for ten minutes and then the water was allowed to cool to 85° C. and the cooking continued for three hours at 80° to 85° C.

The losses in weight during cooking were as follows:

First test:

Weight of meat before cooking	grams	1,648.31
Weight of meat after cooking	do	1,232.26
Loss in weight in cooking	do	416.05
Loss in weight in cooking	per cent	25.24

Second test:

Weight of meat before cooking	grams	1,949.09
Weight of meat after cooking	do	1,463.09
Loss in weight in cooking	do	486.00
Loss in weight in cooking	per cent	24.93

The amounts and proportions of the nutrients of the cooked meat and broth are shown in the following table:

TABLE 14.—*Results of cooking (boiling) experiment No. 40.*

	First test.				Second test.			
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1181	799.50	347.62	62.97	12.94	1182	999.43	386.26	63.35	14.48
In broth	1181	379.49	27.86	2.39	6.31	1182	452.76	26.18	1.17	5.89
In uncooked meat	1181a	1,178.99	375.48	65.36	19.25	1182a	1,452.19	412.44	64.52	20.37
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	67.81	92.58	96.34	67.22	.....	68.82	93.65	98.19	71.08
In broth	.....	32.19	7.42	3.66	32.78	.....	31.18	6.35	1.81	28.92
In broth on basis of total weight of uncooked meat	.....	23.02	1.69	.14	.38	.....	23.22	1.35	.06	.30

COOKING EXPERIMENT NO. 41.

This experiment was undertaken to determine the kind and amount of nutrients of mutton which passed into the broth in boiling. The cut selected was leg, and in each of the two tests the meat was plunged at once into boiling water, which was kept as near as possible to the boiling point for ten minutes. The temperature was then allowed to fall to 85° C., and the cooking continued for three hours at 80° to 85° C.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	912.82
Weight of meat after cooking	do	616.52
Loss in weight in cooking	do	296.30
Loss in weight in cooking	per cent	32.46
Second test:		
Weight of meat before cooking	grams	1,268.14
Weight of meat after cooking	do	847.39
Loss in weight in cooking	do	420.75
Loss in weight in cooking	per cent	33.18

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 15.—*Results of cooking (boiling) experiment No. 41.*

	Laboratory No.	First test. Water.	Protein.	Fat.	Ash.	Laboratory No.	Second test. Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1183	355.54	170.16	88.47	6.47	1184	457.17	212.01	175.33	6.69
In broth	1183	238.35	13.33	41.10	3.52	1184	311.71	16.67	88.14	4.23
In uncooked meat	1183a	593.89	183.49	129.57	9.99	1184a	768.88	228.68	263.47	10.92
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	59.87	92.74	96.83	64.77	.....	59.46	92.71	66.55	61.26
In broth	.....	40.13	7.26	31.72	35.23	.....	40.54	7.29	33.45	38.74
In broth on basis of total weight of uncooked meat	.....	26.11	1.46	4.50	.39	.....	24.58	1.31	6.95	.33

COOKING EXPERIMENT NO. 42.

This experiment was undertaken to determine whether common salt affected the kind and amount of nutrients which passed into the broth when beef was cooked. In each of the two tests reported a piece of lean beef round was plunged into 2,000 cubic centimeters of boiling distilled water containing 200 grams of common salt, and the water was kept as near the boiling point as possible for ten minutes. The temperature was then allowed to drop to 85° C., and the cooking continued for three hours at 80° to 85° C.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	1,945.56
Weight of meat after cooking	do	1,266.87
Loss in weight in cooking	do	678.69
Loss in weight in cooking	per cent	34.88
Second test:		
Weight of meat before cooking	grams	2,190.12
Weight of meat after cooking	do	1,320.36
Loss in weight in cooking	do	869.76
Loss in weight in cooking	per cent	39.71

The quantity of salt used was purposely large in proportion to the size of the cut of meat in order that any effects due to its presence might be plainly evident. In this experiment the attempt was made to determine the composition of the clear broth as shown by the methods previously described, but owing to the large amount of salt considerable trouble was experienced. It was very difficult to dry the total solids to a constant weight in the water oven; however, fairly good results were finally obtained. During cooking considerable quantities of salt had been absorbed by the meat, and as the amount could not be satisfactorily determined it was impossible to tell what proportion of the total solids was due to salt and what proportion to solids originally present in the meat but dissolved during cooking. Owing to the lack of satisfactory methods, it was also impossible to determine what proportion of the ash of the clear broth was added salt.

The following table shows the amounts and proportions of nutrients in the cooked meat and the broth, the results being less complete than usual for the reasons just given:

TABLE 16.—*Results of cooking (boiling) experiment No. 42.*

	First test.					Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1187	718.07	364.60	165.45	17.74	1188	735.57	439.15	128.07	16.37
In broth	1187	.....	15.51	12.24	.....	1188	.....	18.07	36.09	.....
In uncooked meat	1187a	.....	380.11	177.69	.....	1188a	.....	456.22	164.16	.....
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	.....	95.92	93.11	.....	.....	.....	96.05	78.02	.....
In broth	.....	.....	4.08	6.89	.....	.....	.....	3.95	21.98	.....
In broth on basis of total weight of uncooked meat	.....	.....	.80	.63	.....	.....	.....	.83	1.65	.....

COOKING EXPERIMENT NO. 43.

The object of this experiment, which included two tests, was to determine the effect of common salt upon the kind and amount of nutrients which pass into the broth when veal is cooked. The cut selected was leg, and the meat was cooked as in the preceding experiment No. 42.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	1,835.07
Weight of meat after cooking	do	1,332.63
Loss in weight in cooking	do	503.44
Loss in weight in cooking	per cent	27.43
Second test:		
Weight of meat before cooking	grams	1,988.38
Weight of meat after cooking	do	1,389.04
Loss in weight in cooking	do	599.34
Loss in weight in cooking	per cent	30.14

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth, the results being less full than usual, as previously explained, owing to the salt added during cooking:

TABLE 17.—*Results of cooking (boiling) experiment No. 43.*

	Laboratory No.	First test. Water.	Protein.	Fat.	Ash.	Laboratory No.	Second test. Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1189	823.84	347.42	136.33	18.66	1190	850.23	370.60	140.85	17.37
In broth	1189	.....	12.86	3.49	.....	1190	.....	13.81	3.11	.....
In uncooked meat	1189a	.....	360.28	139.82	.....	1190a	.....	384.41	143.96	.....
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	.....	96.43	97.50	.....	.....	.....	96.41	97.84	.....
In broth	.....	.....	3.57	2.50	.....	.....	.....	3.59	2.16	.....
In broth on basis of total weight of uncooked meat	.....	.....	.70	.19	.....	.....	.....	.69	.16	.....

COOKING EXPERIMENT NO. 44.

This experiment, which included two tests, was undertaken to determine the effect of common salt upon the amount and proportion of the nutrients extracted when smoked ham is boiled. The method of cooking and the time it was continued were the same as in experiment No. 42.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	1,410.44
Weight of meat after cooking	do	1,100.28
Loss in weight in cooking	do	310.16
Loss in weight in cooking	per cent	21.99
Second test:		
Weight of meat before cooking	grams	1,663.98
Weight of meat after cooking	do	1,307.53
Loss in weight in cooking	do	356.45
Loss in weight in cooking	per cent	21.42

The amounts and proportions of nutrients of cooked ham and broth follow, as previously explained, the results being less complete than when salt is not added during cooking.

TABLE 18.—*Results of cooking (boiling) experiment No. 44.*

	Laboratory No.	First test. Water.	Protein.	Fat.	Ash.	Laboratory No.	Second test. Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat..	1191	434.61	151.95	474.00	.....	1192	660.17	270.92	264.25	.....
In broth	1191	.....	6.87	56.27	.....	1192	.....	6.68	12.95	.....
In uncooked meat	1191a	.....	158.82	530.27	.....	1192a	.....	277.60	277.20	.....
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat..	.....	.....	95.67	89.39	.....	.....	.....	97.59	95.33	.....
In broth	.....	.....	4.33	10.61	.....	.....	.....	2.41	4.67	.....
In broth on basis of total weight of uncooked meat	.....	.....	.49	3.99	.....	.....	.....	.40	.78	.....

COOKING EXPERIMENT NO. 45.

This experiment, which is divided into two tests, was made to ascertain the kind and amount of nutrients which pass into the broth when beef round is cooked in water containing salt and is in so far as possible a duplicate of experiment No. 42.

The losses in weight during cooking were as follows:

First test:

Weight of meat before cooking	grams..	1,529.64
Weight of meat after cooking	do....	959.13
Loss in weight in cooking	do....	570.51
Loss in weight in cooking	per cent..	37.30

Second test:

Weight of meat before cooking	grams..	1,615.56
Weight of meat after cooking	do....	1,014.62
Loss in weight in cooking	do....	600.94
Loss in weight in cooking	per cent..	37.20

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 19.—*Results of cooking (boiling) experiment No. 45.*

	Laboratory No.	First test. Water.	Protein.	Fat.	Ash.	Laboratory No.	Second test. Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat..	1193	592.22	291.48	55.73	18.22	1194	611.21	318.21	66.46	14.31
In broth	1193	.....	14.04	11.36	.....	1194	.....	13.42	9.68	.....
In uncooked meat	1193a	.....	305.52	67.09	.....	1194a	.....	331.63	76.14	.....
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat..	.....	.....	95.41	83.07	.....	.....	.....	95.98	87.29	.....
In broth	.....	.....	4.59	16.93	.....	.....	.....	4.02	12.71	.....
In broth on basis of total weight of uncooked meat	.....	.....	.92	.74	.....	.....	.....	.83	.60	.....

COOKING EXPERIMENT NO. 48.

The object of this experiment was to determine the influence of long and short periods of cooking upon the composition of meat and broth. Lean beef round from an animal about 2½ years old was used in each of the two tests. In each case the meat was plunged into boiling water, the temperature being maintained for ten minutes as near that point as possible. It was then gradually reduced to 80° to 85° C., and the cooking continued with one piece of meat for two hours, and with the other for five hours.

The losses in weight during cooking were as follows:

First test:		
Weight of meat before cooking	grams	1,237.90
Weight of meat after cooking	do	761.85
Loss in weight in cooking	do	476.05
Loss in weight in cooking	per cent	38.46
Second test:		
Weight of meat before cooking	grams	1,210.15
Weight of meat after cooking	do	654.70
Loss in weight in cooking	do	555.45
Loss in weight in cooking	per cent	45.90

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 20.—*Results of cooking (boiling) experiment No. 48.*

	First test.				Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1205	507.92	235.94	15.91	6.17	1206	405.66	235.36	10.80	4.91
In broth	1205	452.02	17.72	.75	5.55	1206	523.95	23.66	.63	7.21
In uncooked meat	1205a	959.94	253.66	15.76	11.72	1206a	929.61	259.02	11.43	12.12
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	.....	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	52.91	93.01	95.24	52.65	.....	43.64	90.87	94.49	40.51
In broth	.....	47.09	6.99	4.76	47.35		56.36	9.13	5.51	59.49
In broth on basis of total weight of uncooked meat	.....	36.52	1.43	.06	.45	.....	43.30	1.95	.05	.60

COOKING EXPERIMENT NO. 51.

The object of this experiment, like that of the preceding, was to determine the effect of cooking for short and long periods upon the composition of beef and broth. The meat selected for each of the two tests into which the experiment was divided was lean beef round from an animal about 3 years old. The experimental methods were the same as in the preceding test, one piece being cooked for two hours and the other for five hours.

The losses in weight during cooking were as follows:

First test:

Weight of meat before cooking	grams	2,141.09
Weight of meat after cooking	do	1,443.34
Loss in weight in cooking	do	697.75
Loss in weight in cooking	per cent	32.59

Second test:

Weight of meat before cooking	grams	1,529.94
Weight of meat after cooking	do	858.52
Loss in weight in cooking	do	671.42
Loss in weight in cooking	per cent	43.89

The following table shows the amounts and proportions of nutrients of the cooked meat and broth:

TABLE 21.—*Results of cooking (boiling) experiment No. 51.*

	First test.					Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1211	967.18	440.80	25.69	13.28	1212	522.84	297.90	32.62	6.18
In broth	1211	660.99	27.52	.65	8.59	1212	631.58	26.54	4.86	8.44
In uncooked meat	1211a	1,628.17	468.32	26.34	21.87	1212a	1,154.43	324.44	37.48	14.62
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	59.38	94.12	97.53	60.72	.....	45.29	91.82	87.03	42.27
In broth	.....	40.62	5.88	2.47	39.28	.....	54.71	8.18	12.97	57.73
In broth on basis of total weight of uncooked meat	.....	30.87	1.46	.03	.40	.....	41.28	1.73	.32	.55

COOKING EXPERIMENT NO. 54.

The object of this experiment, which was divided into two tests and made with lean beef round from an animal 3 years old, was the same as in experiment No. 48 and was made by the same methods, the cooking being continued with one sample for two hours and with the other for five hours.

The losses in weight during cooking were as follows:

First test:

Weight of meat before cooking	grams	2,108.62
Weight of meat after cooking	do	1,459.90
Loss in weight in cooking	do	648.72
Loss in weight in cooking	per cent	30.76

Second test:

Weight of meat before cooking	grams	1,128.00
Weight of meat after cooking	do	717.30
Loss in weight in cooking	do	410.70
Loss in weight in cooking	per cent	36.41

The amounts and proportions of the nutrients of the cooked meat and broth follow:

TABLE 22.—*Results of cooking (boiling) experiment No. 54.*

	Laboratory No.	First test.				Laboratory No.	Second test.			
		Water.	Protein.	Fat.	Ash.		Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1242	993.32	411.84	50.36	13.43	1243	459.14	231.47	26.47	5.45
In broth	1242	617.72	22.29	1.50	6.21	1243	386.00	16.68	2.69	5.33
In uncooked meat	1242a	1,611.04	434.13	51.86	20.64	1243a	845.14	248.15	29.16	10.78
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	.....	61.66	94.87	97.11	65.07	.....	54.33	93.28	90.78	50.55
In broth	.....	38.34	5.13	2.89	34.93	.....	45.67	6.72	9.22	49.45
In broth on basis of total weight of uncooked meat	.....	29.30	1.04	.07	.34	.....	34.22	1.47	.24	.47

COOKING EXPERIMENT NO. 59.

The object of this and of several of the experiments following was to determine the effect upon the amount and composition of the materials which pass into the broth: (1) Of the size of the piece of meat selected, (2) of first soaking the meat in cold water, and (3) of then cooking it for a long time at a temperature considerably lower than 100° C. The cut of meat selected for this and the three following experiments was lean beef round. All visible gristle was removed, leaving the fat and lean. The whole piece was then cut into cubes about one-half inch square. In the present experiment 500 grams of this beef were placed in a kettle of suitable size and just covered with cold distilled water (710 cubic centimeters) and allowed to stand for one hour. The water was then gradually heated and at the end of an hour had a temperature of 50° C. The cooking was continued for four hours, the temperature varying from 47° to 50° C. After the cooking was completed the warm broth was strained through a sieve, with meshes about 1 millimeter square, of the sort ordinarily used in the household for this purpose.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	500.00
Weight of meat after cooking	do	391.84
Loss in weight in cooking	do	108.16
Loss in weight in cooking	per cent	21.63

In addition to the usual determinations, an air-dried sample of the cooked meat was extracted with water and the total solids (protein, extractives, and ash) in the extract determined. The following table shows the amounts and proportions of the nutrients in the cooked meat and broth and in the water extract of the cooked meat:

TABLE 23.—*Results of cooking (boiling) experiment No. 59.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1368	.....	260.96	95.33	.....	36.56	2.27
In broth	1368	.....	92.63	11.68	.....	.78	3.07
In uncooked meat	1368a	.....	353.59	107.01	.....	37.34	5.34
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	73.80	89.09	.....	97.92	42.51
In broth	.....	.....	26.20	10 91	.....	2.08	57.49
In broth on basis of total weight of uncooked meat	.....	.....	18.52	2.34	.....	.16	.61
Proportion of nutrients of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1368	1.68	.....	.27	.96	.....	.45
Calculated to water-free basis	1368	4.91	.....	.79	2.81	.....	1.31

COOKING EXPERIMENT NO. 60.

The object of this experiment was to determine the effect of the size of the sample upon the kind and amount of the nutrients which pass into the broth. This experiment was made with some of the same meat and by the same methods as experiment No. 59, except that the sample selected was larger, weighing 2,500 grams, and 1,363 cubic centimeters of water were used.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	2,500.00
Weight of meat after cooking	do	1,994.39
Loss in weight in cooking	do	505.61
Loss in weight in cooking	per cent	20.22

The amounts and proportions of the nutrients of the cooked meat and broth, and also the composition of the water extract of the cooked meat, are shown in the following table:

TABLE 24.—*Results of cooking (boiling) experiment No. 60.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1369	.....	1,322.68	455.72	.....	211.80	12.37
In broth	1369	.....	431.20	56.09	.....	3.99	12.34
In uncooked meat	1369a	.....	1,753.88	511.81	.....	215.79	24.71
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	75.41	89.04	.....	98.15	50.00
In broth	.....	.....	24.59	10.96	.....	1.85	50.00
In broth on basis of total weight of uncooked meat	.....	.....	17.25	2.24	.....	.16	.49
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1369	5.01	.....	.64	3.81	.....	.56
Calculated to water-free basis	1369	14.70	.....	1.88	11.18	.....	1.64

COOKING EXPERIMENT NO. 61.

The object of this experiment was to determine the influence of the size of the sample upon the kind and amount of nutrients which pass into the broth when beef is cooked at a fairly high temperature, though under 100° C. A sample weighing 500 grams of the same beef as was used in experiments Nos. 59 and 60 was placed in a kettle containing sufficient boiling water to cover the meat. The temperature was maintained for ten minutes and then allowed to drop to 85° C., and the cooking was continued for two hours longer, the temperature varying from 80° to 85° C.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	500.00
Weight of meat after cooking	do	293.57
Loss in weight in cooking	do	206.43
Loss in weight in cooking	per cent	41.29

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth and also the composition of the water extract of the cooked meat:

TABLE 25.—*Results of cooking (boiling) experiment No. 61.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1370	.....	159.56	92.71	.....	42.54	1.67
In broth	1370	.....	184.42	12.06	.....	6.30	3.35
In uncooked meat	1370a	.....	343.98	104.77	.....	48.84	5.02
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	46.35	88.49	.....	87.10	46.99
In broth	.....	.....	53.65	11.51	.....	12.90	53.01
In broth on basis of total weight of uncooked meat	.....	.....	36.94	2.62	.....	1.26	.67
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1370	1.69	.....	.23	1.03	.....	.43
Calculated to water-free basis	1370	2.98	.....	.41	1.81	.....	.76

COOKING EXPERIMENT NO. 62.

The object of this experiment, like the preceding, was to study the effect of the quantity of meat upon the composition of the resulting broth, some of the same beef round being used as in experiments Nos. 59, 60, and 61. The meat was cut into cubes one-half inch square, and 2,500 grams were placed in a suitable kettle containing sufficient boiling water to cover it. The water was maintained at the boiling point for fifteen minutes, then cooled to 85° C. and the cooking continued for two hours at 80° to 85° C.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	2,500.00
Weight of meat after cooking	do	1,244.98
Loss in weight in cooking	do	1,255.02
Loss in weight in cooking	per cent	50.20

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth as well as the composition of the aqueous extract of the cooked meat:

TABLE 26.—*Results of cooking (boiling) experiment No. 62.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1371	.....	673.13	406.52	.....	158.08	7.46
In broth	1371	.....	1,148.07	58.44	.....	33.13	15.38
In uncooked meat	1371a	.....	1,821.20	464.96	.....	191.21	22.84
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	36.95	87.43	.....	82.67	32.66
In broth	.....	.....	63.05	12.57	.....	17.33	67.34
In broth on basis of total weight of uncooked meat	.....	.....	45.92	2.33	.....	1.33	.62
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1371	1.74	.....	.33	1.08	.....	.33
Calculated to water-free basis	1371	3.79	.....	.72	2.35	.....	.72

COOKING EXPERIMENT NO. 63.

The object of this experiment and Nos. 64, 65, and 66 was to determine the effect of the quantity of meat used upon the composition of the broth. A piece of lean beef round, freed from visible fat and gristle, was divided into four pieces, two of which weighed approximately 500 grams and two approximately 2,500 grams each. One of the smaller pieces was covered with cold distilled water (1,965 cubic centimeters) and allowed to stand for one hour. The water was then gradually heated and at the end of an hour had reached 50° C. The cooking was then continued for four hours, the temperature varying from 47° to 50° C.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	520.77
Weight of meat after cooking	do	413.11
Loss in weight in cooking	do	107.66
Loss in weight in cooking	per cent	20.67

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth and the composition of the aqueous extract of the cooked meat:

TABLE 27.—*Results of cooking (boiling) experiment No. 63.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1376	.....	289.63	112.05	.....	11.88	3.13
In broth	1376	.....	94.40	10.14	.....	.26	2.86
In uncooked meat	1376a	.....	384.03	122.19	.....	12.14	5.99
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	75.42	91.70	.....	97.85	51.92
In broth	.....	.....	24.58	8.30	.....	2.14	48.08
In broth on basis of total weight of uncooked meat	.....	.....	18.13	1.95	.....	.05	55
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1376	2.32	.....	.09	1.61	.....	.62
Calculated to water-free basis	1376	7.77	.....	.29	5.46	.....	2.02

COOKING EXPERIMENT NO. 64.

In this test a large piece of meat was cooked under practically the same conditions as in experiment No. 63. The piece of lean beef round was covered with cold distilled water (710 cubic centimeters), allowed to stand for one hour, and then gradually heated until the temperature of the water was 50° C. The cooking was continued for four hours at 47° to 50° C.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	2,384.54
Weight of meat after cooking	do	1,886.23
Loss in weight in cooking	do	498.31
Loss in weight in cooking	per cent	20.89

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth and the composition of the water extract of the cooked meat.

TABLE 28.—*Results of cooking (boiling) experiment No. 64.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1377	.....	1,277.92	438.74	.....	168.06	15.47
In broth	1377	.....	445.67	40.11	.....	3.05	9.48
In uncooked meat	1377a	.....	1,723.59	478.85	.....	171.11	24.95
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	74.14	91.62	.....	98.22	62.00
In broth	.....	.....	25.86	8.38	.....	1.78	38.00
In broth on basis of total weight of uncooked meat	.....	.....	18.69	1.68	.....	.13	.40
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1377	7.92	.....	.70	6.47	.....	.75
Calculated to water-free basis	1377	24.01	.....	2.12	19.62	.....	2.27

COOKING EXPERIMENT NO. 65.

This experiment, like No. 63, was made with a small piece of lean beef round. The meat was plunged into boiling distilled water, sufficient to cover it, the temperature being maintained for ten minutes, and then allowed to fall to 85° C. The cooking was continued for two hours, the temperature varying from 80° to 85° C.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	501.41
Weight of meat after cooking	do	288.03
Loss in weight in cooking	do	213.38
Loss in weight in cooking	per cent	42.55

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth and the composition of the water extract:

TABLE 29.—*Results of cooking (boiling) experiment No. 65.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1378	.....	161.12	103.86	.....	22.75	4.01
In broth	1378	.....	196.03	8.60	.....	5.52	3.23
In uncooked meat	1378a	.....	357.15	112.46	.....	28.27	7.24
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	45.13	92.35	.....	80.47	55.39
In broth	.....	.....	54.87	7.65	.....	19.53	44.61
In broth on basis of total weight of uncooked meat	.....	.....	39.09	1.72	.....	1.10	.65
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1378	2.42	.....	.09	1.58	.....	.75
Calculated to water-free basis	1378	5.36	.....	.20	3.51	.....	1.65

COOKING EXPERIMENT NO. 66.

As in experiment No. 64, a large piece of beef round was used to study the effect of the quantity of meat upon the composition of the broth. The method of cooking was the same as in experiment No. 65.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	2,502.55
Weight of meat after cooking	do	1,543.47
Loss in weight in cooking	do	959.08
Loss in weight in cooking	per cent	38.32

The amounts and proportions of the nutrients in the cooked meat and broth are shown in the following table, as well as the composition of the water extract of the cooked beef:

TABLE 30.—*Results of cooking (boiling) experiment No. 66.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1379	.....	901.85	506.26	.....	132.12	14.82
In broth	1379	.....	890.12	42.79	.....	15.70	10.47
In uncooked meat	1379a	.....	1,791.97	549.05	.....	147.82	25.29
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	50.33	92.21	.....	89.38	58.60
In broth	.....	.....	49.67	7.79	.....	10.62	41.40
In broth on basis of total weight of uncooked meat	.....	.....	35.57	1.69	.....	.63	.42
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1379	2.63	.....	.07	1.78	.....	.78
Calculated to water-free basis	1379	6.22	.....	.16	4.22	.....	1.84

COOKING EXPERIMENT NO. 67.

Experiments Nos. 67 to 70 are duplicates of Nos. 59 to 62, respectively, and were conducted by the same methods, except that the lean beef round was freed from all visible gristle and cut into cubes about one-half inch square and thoroughly mixed. A portion weighing about 500 grams was soaked in cold distilled water (600 cubic centimeters) and cooked at a temperature of 47° to 50° C., as in experiment No. 59.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	500.00
Weight of meat after cooking	do	384.20
Loss in weight in cooking	do	115.80
Loss in weight in cooking	per cent	23.16

The following table shows the amounts and proportions of the nutrients of the cooked meat and the broth, as well as the composition of the aqueous extract of the cooked meat:

TABLE 31.—*Results of cooking (boiling) experiment No. 67.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1380	.....	262.41	89.40	.....	32.66	1.92
In broth	1380	.....	102.06	9.50	.....	.97	3.27
In uncooked meat	1380a	.....	364 47	98.90	.....	33.63	5.19
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	72.00	90.39	.....	97.12	36.99
In broth	.....	.....	28.00	9.61	.....	2.88	63.01
In broth on basis of total weight of uncooked meat	.....	.....	20.41	1.90	.....	.19	.65
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1380	1.84	.....	.13	1.23	.....	.48
Calculated to water-free basis	1380	5.68	.....	.40	3.80	.....	1.48

COOKING EXPERIMENT NO. 68.

In this test 2,500 grams of beef round cut into small cubes were soaked for one hour in cold distilled water (1,210 cubic centimeters), and cooked at 47° to 50° C. as in the preceding test.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	2,500.00
Weight of meat after cooking	do	2,026.10
Loss in weight in cooking	do	473.90
Loss in weight in cooking	per cent	18.82

The following table shows the amounts and proportions of the nutrients of the cooked meat and the broth, as well as the composition of the water extract of the cooked meat:

TABLE 32.—*Results of cooking (boiling) experiment No. 68.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1381	.....	1,376.33	465.19	.....	181.94	17.63
In broth	1381	.....	398.88	58.56	.....	3.66	11.80
In uncooked meat	1381a	.....	1,775.21	523.75	.....	185.60	29.43
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	77.53	88.82	.....	98.03	59.91
In broth	.....	.....	22.47	11.18	.....	1.97	40.09
In broth on basis of total weight of uncooked meat	.....	.....	15.96	2.34	.....	.15	.47
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1381	3.96	.....	.17	3.09	.....	.70
Calculated to water-free basis	1381	12.10	.....	.52	9.45	.....	2.13

COOKING EXPERIMENT NO. 69.

In this test a small quantity, about 500 grams, of beef round cut into cubes was plunged into boiling water, and, after ten minutes at this temperature, was cooked for two hours at 80° to 85° C. as in experiment No. 61.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	500.00
Weight of meat after cooking	do	277.29
Loss in weight in cooking	do	222.71
Loss in weight in cooking	per cent	44.54

The amounts and proportions of the nutrients of the cooked meat and broth, as well as the composition of the water extract of the cooked meat, are shown in the following table:

TABLE 33.—*Results of cooking (boiling) experiment No. 69.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weights of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1382	.....	152.84	91.33	.....	34.36	1.83
In broth	1382	.....	204.48	11.01	.....	4.01	3.21
In uncooked meat	1382a	.....	357.32	102.34	.....	38.37	5.04
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	42.77	89.25	.....	89.55	36.31
In broth	.....	.....	57.23	10.75	.....	10.45	63.69
In broth on basis of total weight of uncooked meat	.....	.....	40.90	2.21	.....	.80	.64
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1382	1.72	.....	.11	1.09	.....	.52
Calculated to water-free basis	1382	4.62	.....	.24	3.25	.....	1.13

COOKING EXPERIMENT NO. 70.

This test was a duplicate of the preceding, except that the quantity of beef round cut into small cubes was fairly large, weighing 2,500 grams. The meat was plunged into boiling water for fifteen minutes and then cooked for two hours at a temperature of 80° to 85° C.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams	2,500.00
Weight of meat after cooking	do	1,369.40
Loss in weight in cooking	do	1,130.60
Loss in weight in cooking	per cent	45.22

The amounts and proportions of the nutrients of the cooked meat and broth, as well as the composition of the water extract of the cooked meat, are shown in the following table:

TABLE 34.—*Results of cooking (boiling) experiment No. 70.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1383	.....	463.17	465.87	.....	147.21	10.27
In broth	1383	.....	1,026.31	66.77	.....	22.17	15.35
In uncooked meat	1383a	.....	1,489.48	532.64	.....	169.38	25.62
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	31.10	87.46	.....	86.91	40.09
In broth	.....	.....	68.90	12.54	.....	13.09	59.91
In broth on basis of total weight of uncooked meat	.....	.....	41.05	2.67	.....	.89	.61
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1383	2.11	.....	.05	1.47	.....	.59
Calculated to water-free basis	1383	4.63	.....	.11	3.22	.....	1.30

COOKING EXPERIMENT NO. 71.

In experiments Nos. 71 to 74, like a number of the preceding, the object was to determine the effect of the quantity of beef used upon the composition of the broth. Lean beef round from an animal about 3 years old was freed from gristle, fat, and any dried portions and divided into four parts, two weighing about 500 grams and two about 2,500 grams each. One of the smaller portions was placed in 1,500 cubic centimeters of cold distilled water, soaked for an hour, and cooked at a comparatively low temperature, as in experiment No. 63.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams..	500.00
Weight of meat after cooking	do....	372.02
Loss in weight in cooking	do....	127.98
Loss in weight in cooking	per cent..	25.60

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth, as well as the composition of the aqueous extract of the cooked meat:

TABLE 35.—*Results of cooking (boiling) experiment No. 71.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1384	.....	250.44	100.89	.....	20.68	3.01
In broth	1384	.....	112.92	12.20	.....	.43	2.43
In uncooked meat	1384a	.....	363.36	113.09	.....	21.11	5.44
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	68.92	89.21	.....	97.96	55.33
In broth	.....	.....	31.08	10.79	.....	2.04	44.67
In broth on basis of total weight of uncooked meat	.....	.....	22.58	2.44	.....	.09	.49
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1384	2.50	.....	.08	1.77	.....	.65
Calculated to water-free basis	1384	7.47	.....	.24	5.29	.....	1.94

COOKING EXPERIMENT NO. 72.

One of the larger samples of beef, mentioned in the description of the preceding experiment, was soaked in 2,000 cubic centimeters of cold distilled water, and then cooked at a low temperature, as in experiment No. 64.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams..	2,500.00
Weight of meat after cooking	do....	2,023.61
Loss in weight in cooking	do....	476.39
Loss in weight in cooking	per cent..	19.06

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth, as well as the composition of the water extract of the cooked meat:

TABLE 36.—*Results of cooking (boiling) experiment No. 72.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1385	.....	1,302.19	488.30	.....	231.91	17.20
In broth	1385	.....	425.24	38.36	.....	4.97	7.82
In uncooked meat	1385a	.....	1,727.43	526.66	.....	236.88	25.02
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	75.38	92.72	.....	97.90	68.74
In broth	.....	.....	24.62	7.28	.....	2.10	31.26
In broth on basis of total weight of uncooked meat	.....	.....	17.01	1.53	.....	.20	.31
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1385	4.83	.....	.37	3.64	.....	.82
Calculated to water-free basis	1385	13.23	.....	1.02	9.96	.....	2.25

COOKING EXPERIMENT NO. 73.

One of the smaller pieces of beef, mentioned in the description of experiment No. 71, was plunged into boiling water for ten minutes and then cooked for two hours at 80° to 85° C., as in experiment No. 65.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams..	500.00
Weight of meat after cooking	do...	285.07
Loss in weight in cooking	do...	214.93
Loss in weight in cooking	per cent..	42.99

The amounts and proportions of the nutrients of the cooked meat and broth as well as the composition of the water extract of cooked meat are shown in the following table:

TABLE 37.—*Results of cooking (boiling) experiment No. 73.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1386	.....	160.01	100.34	.....	25.63	1.97
In broth	1386	.....	197.64	10.91	.....	3.03	3.35
In uncooked meat	1386a	.....	357.65	211.25	.....	28.66	5.32
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	44.74	94.84	.....	89.43	37.03
In broth	.....	.....	55.26	5.16	.....	10.57	62.97
In broth on basis of total weight of uncooked meat	.....	.....	39.53	2.18	.....	.61	.67
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1386	2.08	.....	.09	1.38	.....	.61
Calculated to water-free basis	1386	4.66	.....	.20	3.10	.....	1.36

COOKING EXPERIMENT NO. 74.

One of the larger pieces of beef round, mentioned in the description of experiment No. 71, was plunged into boiling water and the temperature maintained for ten minutes, and then cooked at a temperature of 80° to 85° C., as in experiment No. 65.

The losses in weight during cooking were as follows:

Weight of meat before cooking	grams..	2,500.00
Weight of meat after cooking	do....	1,819.01
Loss in weight in cooking	do....	680.99
Loss in weight in cooking	per cent..	27.24

The following table shows the amounts and proportions of the nutrients of the cooked meat and broth, as well as the aqueous extract of the cooked meat:

TABLE 38.—*Results of cooking (boiling) experiment No. 74.*

	Laboratory No.	Total solids.	Water.	Protein.	Nitrogenous extractives.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*	*Grams.*
In cooked meat	1387	.....	1,134.52	502.96	.....	167.89	17.10
In broth	1387	.....	630.25	36.59	.....	4.60	9.15
In uncooked meat	1387a	.....	1,764.77	539.55	.....	172.49	26.25
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In cooked meat	.....	.....	64.28	93.22	.....	97.33	65.14
In broth	.....	.....	35.72	6.78	.....	2.67	34.86
In broth on basis of total weight of uncooked meat	.....	.....	25.21	1.46	.....	.18	.33
Proportion of air-dried sample of cooked meat soluble in cold water:							
Calculated to fresh basis	1387	3.17	.....	.11	2.16	.....	.90
Calculated to water-free basis	1387	8.38	.....	.28	5.72	.....	2.38

SUMMARY OF RESULTS OF THE EXPERIMENTS WITH MEATS COOKED BY BOILING.

The following table summarizes the results of all the experiments reported in the preceding pages as well as those obtained in an earlier work[a] carried on at this laboratory, the experiments being arranged according to the length of the cooking period, the method of cooking, and the kind of meat used:

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 102.

TABLE 39.—*Summary of the losses involved in the cooking of meats in water.*

Cooking experiment No.	Laboratory No.	Meat used for cooking.			Method of cooking.			Nutrients found in the broth expressed in percentages of total amounts in uncooked meat.				Nutrients in broth expressed in percentages of the total weight of the uncooked meat.				
					Temperature.											
		Kind.	Amount taken.	Fat in cooked meat.	At beginning.	During cooking.	Duration of cooking.	Water.	Protein.	Fat.	Ash.	Total.	Water.	Protein.	Fat.	Ash.
			Grams.	*Per ct.*	° *C.*	° *C.*	*Hours.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
31	1158	Beef round, lean	1,380.20	7.10	100	80–85	1½	37.50	6.04	3.90	33.10	28.70	26.90	0.60	0.20	0.30
28	1095	do	1,211.75	7.27	100	100	2	59.32	8.30	29.69	51.00	45.24	40.96	1.99	1.68	.62
28a	1096	do	1,152.63	7.95	100	100	2	60.50	8.36	29.16	53.60	46.49	42.21	1.95	1.75	.58
		Average of 3 tests	1,182.19	7.61				59.91	8.33	29.42	52.30	45.86	41.58	1.97	1.71	.60
61	1370	Beef round, lean, half-inch cubes	500.00	14.49	100	80–85	2	53.65	11.51	12.90	53.01	41.29	36.94	2.62	1.26	.67
69	1382	do	500.00	12.39	100	80–85	2	57.23	10.75	10.45	63.69	44.54	40.90	2.21	.80	.64
		Average of 2 tests	500.00	13.44				55.44	11.13	11.67	58.35	42.92	38.92	2.41	1.03	.65
62	1371	Beef round, lean, half-inch cubes	2,500.00	12.70	100	80–85	2	63.05	12.67	17.33	67.39	50.20	45.92	2.33	1.33	.62
70	1383	do	2,500.00	10.75	100	80–85	2	68.90	12.54	13.09	59.91	45.22	41.05	2.67	.89	.61
		Average of 2 tests	2,500.00	11.72				65.97	12.60	15.21	63.65	47.71	43.48	2.50	1.11	.61
		Average of 4 tests						60.71	11.87	13.44	61.00	45.31	41.20	2.91	1.07	.63
18	894	Beef round, lean, small piece	433.20	2.70	100	80–85	2	59.50	9.80	24.10	64.00	48.50	45.30	2.10	.40	.70
21	779b	do	660.50	5.87	100	80–85	2	60.00	9.43	24.00	59.50	46.80	43.10	2.00	1.00	.70
23	809b	do	686.00	6.34	100	80–85	2	57.20	9.35	18.30	55.60	44.70	41.20	2.00	.80	.70
22	781b	do	755.00	6.50	100	80–85	2	56.30	9.64	11.80	56.50	43.70	40.60	2.00	.50	.60
		Average of 4 tests	633.68	5.35				58.25	9.55	19.55	58.90	45.92	42.55	2.02	.68	.68
65	1378	Beef round, lean, small piece	501.41	7.90	100	80–85	2	54.87	7.65	19.53	44.61	42.55	39.09	1.72	1.10	.65
21	779a	do	750.00	8.98	100	80–85	2	59.90	8.11	23.30	59.30	46.30	42.50	1.70	1.50	.60
73	1386	do	500.00	8.99	100	80–85	2	55.26	5.16	10.57	62.97	42.99	39.53	2.18	.61	.67
23	809a	do	742.80	9.40	100	80–85	2	57.80	9.16	18.10	64.80	45.00	41.40	1.80	1.20	.60
22	781a	do	657.00	10.31	100	80–85	2	54.80	9.68	13.10	52.60	41.60	38.00	2.10	.90	.60
20	777a	do	825.80	10.52	100	80–85	2	54.80	7.85	16.10	54.40	42.20	38.90	1.50	1.20	.60
20a	777b	do	739.50	11.51	100	80–85	2	56.30	8.16	16.80	54.80	42.90	39.20	1.80	1.30	.60
		Average of 7 tests	673.79	9.66				56.25	7.97	16.79	56.21	43.33	39.80	1.83	1.12	.62
		Average of 11 tests	659.20	8.09				56.97	8.54	17.78	57.19	44.29	40.80	1.90	.96	.64

51	1211	Beef round, lean, large piece	2,141.09	1.78	100	80–85	2	40.62	5.88	2.47	39.28	32.59	30.87	1.46	.03	.40
48	1205	.....do	1,237.90	1.97	100	80–85	2	47.09	6.99	4.76	47.35	38.46	36.52	1.43	.06	.45
54	1242	.....do	2,108.62	3.45	100	80–85	2	38.34	5.13	2.89	34.93	30.76	29.30	1.04	.07	.34
18	895	.....do	2,080.00	3.64	100	80–85	2	55.60	8.71	17.30	51.70	44.50	41.60	1.80	.40	.60
13	714	.....do	2,580.00	5.32	100	80–85	2	35.90	2.70	5.30	33.00	28.50	27.40	.50	.20	.30
13a	715	.....do	2,180.00	6.59	100	80–85	2	47.30	3.00	3.50	36.80	35.80	34.60	.60	.20	.40
		Average of 6 tests	2,054.60	3.79				44.14	5.40	6.04	40.51	35.10	33.38	1.14	.16	.42
66	1379	Beef round, lean, large piece	2,500.00	8.56	100	80–85	2	49.67	7.79	10.62	41.40	38.32	35.57	1.69	.63	.42
19	1027	.....do	2,141.25	8.38	100	80–85	2	54.98	8.84	9.09	49.87	43.18	40.37	1.80	.48	.54
74	1387	.....do	2,500.00	9.23	100	80–85	2	35.72	4.97	2.67	34.86	27.24	25.21	1.46	.18	.33
19	1097	.....do	1,139.48	10.53	100	80–85	2	52.50	8.54	3.85	45.86	40.15	37.66	1.76	.25	.48
		Average of 4 tests	2,070.18	9.18				48.22	7.54	6.56	43.00	37.22	34.70	1.68	.39	.44
		Average of 10 tests	2,060.83	5.95				45.77	6.26	6.25	41.51	35.55	33.91	1.35	.25	.43
16	892	Beef round, fat	1,220.30	19.99	100	80–85	2	48.40	6.50	6.70	45.50	34.40	31.80	1.20	.90	.50
16a	893	.....do	1,477.80	18.88	100	80–85	2	47.40	6.49	7.40	41.50	33.90	31.30	1.10	1.00	.40
26	1091	.....do	1,383.07	12.84	100	80–85	2	48.68	7.38	9.46	44.51	36.72	33.88	1.53	.85	.46
26a	1092	.....do	1,409.64	12.67	100	80–85	2	42.79	6.31	7.27	37.39	31.98	29.60	1.32	.68	.38
35	1172	.....do	1,764.97	15.45	100	80–85	2	39.14	4.16	6.86	27.68	26.56	24.42	1.00	.84	.30
		Average of 5 tests	1,451.16	15.96				45.28	6.17	7.54	39.31	32.71	30.20	1.03	.85	.41
27	1093	Beef, "plate boil," very fat	2,120.13	32.32	100	80–85	2	27.51	3.93	3.02	26.21	16.23	14.43	.74	84	.20
27a	1094	.....do	2,193.89	35.49	100	80–85	2	18.05	3.25	3.59	20.04	10.61	8.67	.61	1.18	.15
		Average of 2 tests	2,157.01	33.90				22.78	3.54	3.31	23.12	13.42	11.55	.67	1.01	.17
4	423	Beef round, lean	1,082.20	3.72	100	80–85	2½	49.20	6.50	10.00	41.60	38.30	36.10	1.50	.20	.50
4a	424	.....do	1,064.90	2.85	100	80–85	2½	52.70	6.10	23.50	47.90	41.00	38.60	1.40	.50	.50
5	425	.....do	1,176.00	3.08	100	80–85	2½	47.60	3.90	7.50	27.80	35.30	33.80	1.00	.20	.30
5a	426	.....do	856.00	6.54	100	80–85	2½	45.20	5.30	9.50	36.50	34.00	31.90	1.20	.50	.40
7	450	.....do	758.00	8.37	100	80–85	2½	48.10	3.70	4.60	48.90	35.30	33.50	.90	.30	.60
7a	453	.....do	888.90	9.12	100	80–85	2½	55.30	4.50	4.40	50.00	41.80	40.10	.90	.20	.60
8	452	.....do	863.40	4.56	100	80–85	2½	58.70	4.30	6.50	56.30	45.20	43.40	1.00	.20	.60
		Average of 7 tests	955.63	5.46				50.97	4.90	5.14	44.14	38.70	36.77	1.13	.30	.50
10	463	Beef round, rather fat	1,300.20	14.25	100	80–85	3	58.10	5.40	37.40	58.30	45.20	38.90	1.10	4.60	.60
10a	465	.....do	1,283.10	15.49	100	80–85	3	56.30	6.30	35.80	57.00	43.80	37.20	1.20	4.90	.50
29	1098	.....do	1,017.05	12.54	100	80–85	3	56.50	9.11	30.90	48.68	44.41	38.97	1.83	3.12	.49
29a	1099	.....do	1,740.51	18.18	100	80–85	3	49.04	8.34	13.31	40.51	36.68	32.97	1.56	1.77	.39
30	1146	.....do	713.60	7.74	100	80–85	3	54.80	8.67	12.20	49.30	42.80	39.90	.90	.60	.50
30a	1147	.....do	2,323.10	10.00	100	80–85	3	46.00	6.86	5.60	42.30	35.10	32.90	.70	.40	.40
		Average of 6 tests	1,396.29	13.03				53.46	7.45	22.53	49.35	41.33	36.81	1.21	2.56	.48

TABLE 39.—*Summary of the losses involved in the cooking of meats in water*—Continued.

Cooking experiment No.	Laboratory No.	Meat used for cooking. Kind.	Amount taken.	Fat in cooked meat.	Method of cooking. Temperature. At beginning.	During cooking.	Duration of cooking.	Nutrients found in the broth expressed in percentages of total amounts in uncooked meat. Water.	Protein.	Fat.	Ash.	Nutrients in broth expressed in percentages of the total weight of the uncooked meat. Total.	Water.	Protein.	Fat.	Ash.
			Grams.	*Per ct.*	° *C.*	° *C.*	*Hours.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
32	1160	Beef, "plate boil," very fat	1,715.90	50.14	100	80–85	3	34.90	5.71	11.70	31.60	20.80	14.60	0.70	5.30	0.20
32a	1161	.....do	1,825.80	50.73	100	80–85	3	40.10	6.65	18.30	41.70	25.80	16.30	.80	8.50	.20
33	1162	Beef neck, very fat	2,393.20	23.62	100	80–85	3	25.70	4.47	4.10	23.50	17.40	15.60	.80	.80	.20
33a	1163	.....do	2,729.80	29.87	100	80–85	3	26.90	3.85	1.30	21.60	16.50	15.40	.60	.30	.20
34	1169	Beef ribs, very fat	1,806.37	26.04	100	80–85	3	37.14	5.73	13.07	35.30	26.54	22.43	.98	2.88	.25
34a	1170	.....do	1,923.58	34.06	100	80–85	3	31.68	4.67	9.65	29.70	20.44	16.52	.82	2.90	.21
		Average of 6 tests	2,065.77	35.74	.....	.....	.....	32.74	5.18	9.69	30.60	21.24	16.81	.78	4.78	.21
38	1177	Veal leg	1,774.20	7.79	100	80–85	3	41.40	7.71	13.10	34.30	33.00	30.40	1.50	.80	.30
38a	1178	.....do	2,334.70	4.18	100	80–85	3	39.20	8.61	4.40	30.70	31.60	29.90	1.30	.10	.30
40	1181	.....do	1,648.31	5.11	100	80–85	3	32.19	7.42	3.66	32.78	25.24	23.02	1.69	.14	.38
40a	1182	.....do	1,949.09	4.33	100	80–85	3	31.18	6.35	1.81	28.92	24.93	23.22	1.35	.06	.30
		Average of 4 tests	1,926.58	5.35	.....	.....	.....	35.99	7.52	5.74	31.67	28.69	26.63	1.46	.27	.32
39	1179	Mutton, leg	964.70	25.50	100	80–85	3	49.80	9.67	34.70	47.60	39.20	28.90	1.60	8.30	.40
39a	1180	.....do	1,284.20	18.57	100	80–85	3	45.20	7.79	30.60	40.00	34.90	27.60	1.60	5.30	.40
41	1183	.....do	912.82	14.35	100	80–85	3	40.13	7.26	31.72	35.23	32.46	26.11	1.46	4.50	.39
41a	1184	.....do	1,268.14	20.69	100	80–85	3	40.54	7.29	33.45	38.74	33.18	24.58	1.31	6.95	.33
		Average of 4 tests	1,107.46	19.78	.....	.....	.....	43.92	8.00	32.62	40.39	34.94	26.80	1.49	6.26	.38
36	1173	Pork, fresh ham	1,838.40	32.83	100	80–85	3	33.56	4.94	1.74	27.25	20.43	18.94	.81	.46	.22
36a	1174	.....do	1,608.50	44.66	100	80–85	3	44.87	7.34	12.37	34.14	28.20	22.53	.91	4.53	.24
37	1175	.....do	1,882.66	36.82	100	80–85	3	35.45	5.31	4.68	33.63	21.33	18.84	.82	1.42	.26
37a	1176	.....do	2,016.70	40.64	100	80–85	3	46.10	6.31	6.11	40.54	27.95	24.90	.88	1.91	.28
		Average of 4 tests	1,836.54	38.74	.....	.....	.....	39.99	5.97	6.22	33.89	24.48	21.30	.85	2.08	.25
31a	1159	Beef round, lean	1,435.90	11.18	100	80–85	5	53.90	.....	13.40	54.80	42.00	38.00	.....	1.00	.60
48	1206	.....do	1,210.15	1.65	100	80–85	5	56.30	9.13	5.51	59.49	45.90	43.30	1.95	.05	.60
51	1212	.....do	1,529.94	3.80	100	80–85	5	54.71	8.18	12.97	57.73	43.89	41.28	1.73	.32	.55
54	1243	.....do	1,128.00	3.69	100	80–85	5	45.67	6.72	9.22	49.45	36.41	34.22	1.47	.24	.47
		Average of 4 tests	1,326.00	5.08	.....	.....	.....	52.66	8.01	10.27	55.39	42.05	39.20	1.72	.40	.30

24	820a	Beef round, lean	915.10	6.11	20–25	50	6	17.00	6.76	6.80	31.20	14.30	12.00	1.50	.40	.40
24a	820b	.....do	837.30	6.58	20–25	50	6	27.90	10.29	6.80	41.50	22.90	19.80	2.20	.40	.50
		Average of 2 tests	876.20	6.35	.....	.....	.....	22.45	8.52	6.80	36.35	18.60	15.90	1.85	.40	.45
63	1376	Beef round, lean, one piece	520.77	2.88	20–25	47–50	5	24.58	8.30	2.14	48.08	20.67	18.13	1.95	.05	.55
71	1384	.....do	500.00	5.56	20–25	47–50	5	31.08	10.79	2.04	44.67	25.60	22.58	2.44	.09	.49
		Average of 2 tests	510.38	4.22	.....	.....	.....	27.83	9.54	2.09	46.37	23.13	20.35	2.20	.07	.52
64	1377	Beef round, lean, one piece	2,384.54	8.91	20–25	47–50	5	25.86	8.38	1.78	38.00	20.89	18.69	1.68	.13	.40
72	1385	.....do	2,500.00	11.46	20–25	47–50	5	24.62	7.28	2.10	31.26	19.06	17.01	1.53	.20	.31
		Average of 2 tests	2,442.27	10.18	.....	.....	.....	25.24	7.83	1.94	34.63	19.97	17.85	1.60	.16	.35
59	1368	Beef round, half-inch cubes	500.00	9.33	20–25	47–50	5	26.20	10.91	2.08	57.49	21.63	18.52	2.34	.16	.61
67	1380	.....do	500.00	9.50	20–25	47–50	5	28.00	9.61	2.88	63.01	23.16	20.41	1.90	.19	.65
		Average of 2 tests	500.00	9.41	.....	.....	.....	27.10	10.26	2.48	60.25	22.40	19.47	2.12	.17	.63
60	1369	Beef round, half-inch cubes	2,500.00	10.62	20–25	47–50	5	24.59	10.96	1.85	50.00	20.22	17.25	2.29	.16	.49
68	1381	.....do	2,500.00	8.98	20–25	47–50	5	22.47	11.18	1.97	40.09	18.82	15.96	2.34	.15	.47
		Average of 2 tests	2,500.00	9.80	.....	.....	.....	23.53	11.07	1.91	45.04	19.52	16.60	2.31	.15	.48
		Average of 8 tests	.....	8.41	.....	.....	.....	25.92	9.82	2.11	46.57	21.26	18.57	1.94	.14	.50
35	1171	Beef neck, lean	1,523.68	12.92	20–25	57–60	5	38.23	5.27	4.74	36.73	27.92	25.98	1.13	.46	.34
14	737	Beef round, lean	2,020.00	6.29	20–25	65–70	5½	35.30	3.68	1.20	32.50	27.00	26.20	.30	.10	.40
14a	738	.....do	2,870.00	8.06	20–25	65–70	5½	33.80	3.68	.60	29.00	25.30	24.60	.30	.10	.30
		Average of 2 tests	2,445.00	7.17	.....	.....	.....	34.55	3.68	.90	30.75	26.15	25.40	.30	.10	.35
17	771a	Beef round, lean	705.50	7.23	20–25	80	2¾	50.20	11.38	16.30	56.30	41.00	37.50	2.00	.80	.60
17a	771b	.....do	660.80	8.50	20–25	80	2¾	56.60	10.85	22.00	57.40	41.20	37.30	2.00	1.20	.60
25	823a	.....do	798.10	6.13	20–25	80	2¾	53.80	9.19	.....	53.50	42.20	39.40	1.90	.....	.60
25a	823b	.....do	944.50	3.47	20–25	80	2¾	51.70	7.51	23.90	49.50	40.90	37.80	1.90	.60	.60
		Average of 4 tests	777.25	6.33	.....	.....	.....	53.07	9.73	20.73	54.17	41.33	38.00	1.95	.87	.60
6	437	Beef round, lean	1,623.50	2.43	20–25	80–85	5	56.40	3.78	25.90	44.10	44.20	42.30	.80	.50	.60
6a	438	.....do	1,119.80	3.46	20–25	80–85	5	57.00	3.80	15.40	51.20	44.70	43.00	.80	.30	.60
11	467	.....do	1,222.50	14.25	20–25	80–85	5	.....	7.29	.....	55.40	44.00	.....	.90	.....	.50
11a	469	.....do	1,461.00	21.55	20–25	80–85	5	50.40	6.42	2.70	48.20	34.10	32.40	.80	.40	.50
		Average of 4 tests	1,356.70	10.42	.....	.....	.....	54.60	5.31	14.67	49.72	41.77	39.23	.82	.40	.55

TABLE 39.—*Summary of the losses involved in the cooking of meats in water*—Continued.

Cooking experiment No.	Laboratory No.	Meat used for cooking.			Method of cooking.			Nutrients found in the broth expressed in percentages of total amounts in uncooked meat.				Nutrients in broth expressed in percentages of the total weight of the uncooked meat.				
		Kind.	Amount taken.	Fat in cooked meat.	Temperature.		Duration of cooking.	Water.	Protein.	Fat.	Ash.	Total.	Water.	Protein.	Fat.	Ash.
					At beginning.	During cooking.										
			Grams.	*Per ct.*	° *C.*	° *C.*	*Hours.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
42	1187	Beef round in 10 per cent salt solution	1,945.56	13.06	100	80–85	3	.....	4.08	6.89	.....	34.88	.....	0.80	0.63	.....
42a	1188	....do	2,190.12	9.70	100	80–85	3	.....	3.95	21.98	.....	39.71	.....	.83	1.65	.....
45	1193	....do	1,529.64	5.81	100	80–85	3	.....	4.59	16.93	.....	37.30	.....	.92	.74	.....
45a	1194	....do	1,615.56	6.55	100	80–85	3	.....	4.02	12.71	.....	37.20	.....	.83	.60	.....
		Average of 4 tests	1,820.22	8.78	.....	.....	.....	.....	4.16	14.62	.....	37.27	.....	.85	.90	.....
43	1189	Veal leg in 10 per cent salt solution	1,835.07	10.23	100	80–85	3	.....	3.57	2.50	.....	27.43	.....	.70	.19	.....
43a	1190	....do	1,988.38	10.14	100	80–85	3	.....	3.59	2.16	.....	30.14	.....	.69	.16	.....
		Average of 2 tests	1,911.72	10.18	.....	.....	.....	.....	3.58	2.33	.....	28.78	.....	.70	.17	.....
44	1191	Smoked ham in 10 per cent salt solution	1,410.44	43.08	100	80–85	3	.....	4.33	10.61	.....	21.99	.....	.49	3.99	.....
44a	1192	....do	1,663.98	23.50	100	80–85	3	.....	2.41	4.67	.....	21.42	.....	.40	.78	.....
		Average of 2 tests	1,537.71	33.29	.....	.....	.....	.....	3.37	7.64	.....	21.70	.....	.44	2.39	.....
		Average of 91 tests (without salt)	.....	.....	.....	.....	.....	[a] 45.07	7.25	[b] 11.70	44.63	34.35	30.75	[a] 1.41	[b] 1.21	[a] 0.46
		Highest	.....	.....	.....	.....	.....	[a] 68.90	12.67	[b] 37.40	67.39	50.20	45.92	[a] 2.62	[b] 8.50	[a] .70
		Lowest	.....	.....	.....	.....	.....	[a] 18.05	3.25	[b] .60	20.04	10.61	8.67	[a] .30	[b] .03	[a] .15

[a] Average of 90 tests only.

[b] Average of 89 tests only.

Though it would be manifestly unwise to draw final conclusions without more data, a consideration of the results summarized above leads to a number of general deductions, which are here given. The averages of the 91 tests taken into account do not include those tests in which the meat was cooked in salted water.

The total losses in weight when meat was cooked in hot water varied in the individual tests from 10.61 to 50.20 per cent of the total weight of the fresh meat used, the average being 34.35 per cent. The smallest loss was observed in experiment No. 27a, in which a very fat cut of beef of the sort known as "plate boil" was cooked for ten minutes in boiling water, and then at a temperature of 80° to 85° C. for two hours, and the largest loss was observed in experiment No. 62, in which a fairly large quantity of lean beef round, cut into cubes one-half inch square, was cooked by the same method. The greater part of the material removed by cooking was water, but in all cases a considerable quantity of nitrogenous material, both proteids and extractives, was recovered in the broth, either suspended or in solution, as well as some fat and mineral matter.

The amount of water removed during cooking varied from 18.05 to 68.90 per cent and averaged 45.07 per cent of the total water in uncooked meat. The smallest loss of water was in experiment No. 27a, and the largest in experiment No. 62, which is in accordance with the statement made in the preceding paragraph.

The total protein recovered in the broth varied from 3.25 to 12.67 per cent, averaging 7.25 per cent of the total amount present in the uncooked meat. As in the case of water, the smallest loss of protein was found in experiment No. 27a, and the greatest loss was observed in experiment No. 62, when cubes of lean beef round one-half inch square were cooked in boiling water for a short time and then for a long time at a lower temperature.

The proportion of fat originally present in the raw meat, which was recovered in the broth, varied from 0.60 to 37.40 per cent, averaging 11.70 per cent. The smallest loss of fat was noted in experiment No. 14a, when lean beef round was placed in cold water and then gradually heated and cooked at a low temperature (65° to 70° C.) for 5.5 hours. The greatest loss of fat was observed in experiment No. 10, in which medium fat beef round was cooked for ten minutes in boiling water and then for three hours at a temperature of 80° to 85° C.

The mineral matter recovered in the broth varied from 20.04 to 67.39 per cent of the total in uncooked meat, averaging 44.63 per cent, the smallest loss being found in experiment No. 27a, i. e., the test in which there was the smallest loss of water and protein. The greatest loss was observed in experiment No. 62, in which, as mentioned above, the total loss in weight was greatest.

From an examination of the data in Table 39, it is evident that the fatter kinds and cuts of meat lose less water, protein, and mineral matter when cooked in hot water than do the leaner kinds and cuts. This may be seen by comparing the average of four tests (Nos. 36, 36a, 37, and 37a), made with pork, having an average fat content of 38.74 per cent, with the average of four tests (Nos. 31, 48, 51, and 54), made with lean beef round, having an average fat content of 5.08 per cent, the time and method of cooking in the two series being the same. In the case of the pork the average losses were as follows: Water 39.99, protein 5.97, fat 6.22, and ash 33.89 per cent. In the case of the beef the losses were, water 52.66, protein 8.01, fat 10.27, and ash 55.39 per cent.

The influence of the fat content upon the kind and amount of nutrients extracted in the broth is also shown by the average of six tests (Nos. 32, 32a, 33, 33a, 34, and 34a) in which very fat meat, containing on an average 35.74 per cent, is compared with the results of six tests (Nos. 10, 10a, 29, 29a, 30, and 30a) made with medium fat meat, containing 13.03 per cent, the methods of cooking in the two cases being the same. In the former the average losses were, water 32.74, protein 5.18, fat 9.69, and ash 30.60 per cent. In the latter the losses were, water 53.46, protein 7.45, fat 22.53, and ash 49.35 per cent.

As regards the loss of fat, it appears that the amount of this constituent removed in the broth depends little, if at all, upon the fatness of the meat cooked, but rather on the nature of the fat contained in the meat. So far as can be judged from this investigation, it appears that the fat of different cuts of meat, even from the same animal, varies considerably as regards the ease with which it may be removed by hot or boiling water. The reasons for this are being investigated further in this laboratory.

The experiments summarized in Table 39 clearly indicate that the amount of material recovered in the broth when meat is cooked in hot or boiling water depends directly upon the length of time the cooking is continued. Thus, in experiments Nos. 16, 16a, 26, 26a, and 35, medium fat beef round was cooked for two hours at 80° to 85° C., the average weight of the pieces of meat used being 1,451.16 grams and the average fat content 15.96 per cent. The average losses were, water 45.28, protein 6.17, fat 7.54, and ash 39.31 per cent. In experiments Nos. 10, 10a, 29, 29a, 30, and 30a, similar cuts of meat were cooked for a longer time (three hours). The average losses were, water 53.46, protein 7.45, fat 22.53, and ash 49.35 per cent. The influence of the length of the cooking period is also shown by the averages of the experiments (Nos. 51, 48, 54, 18, 13, 13a, and 31, 48, 51, 54), in which fairly large pieces of beef round of medium fatness were cooked at a temperature of 80° to 85° C. for two hours and five hours, respectively. The losses in the former case were, water 44.14, protein 5.40,

fat 6.04, and ash 40.51 per cent. The average losses observed when meat was cooked for a longer period were, water 52.66, protein 8.01, fat 10.27, and ash 55.39 per cent.

The conclusion seems warranted, therefore, that as a rule, within certain limits, the losses observed when meat is cooked in hot or boiling water are greater the longer the period of cooking.

A consideration of the results of the experiments summarized in Table 39 indicates that the smaller the piece of meat the larger the proportion of material removed in the broth. This can perhaps be seen best by comparing the results of experiments (Nos. 65, 21, 73, 23, 22, 20, and 20a), in which small pieces of meat were cooked, with those (Nos. 51, 48, 54, 18, 13, 13a, 66, 19, 74, and 19a) in which fairly large pieces of medium lean beef were used, the method of cooking being the same in both cases. When the smaller pieces were used the average losses were, water 56.25, protein 7.97, fat 16.79, and ash 56.21 per cent. In the case of the larger pieces the average losses were, water 45.77, protein 6.26, fat 6.25, and ash 41.51 per cent.

In the above-mentioned tests the meat was cooked for ten minutes in boiling water, and the cooking then continued for two hours at a temperature of 80° to 85° C. That similar losses are observed when the meat is cooked at a lower temperature for a longer time may be seen by comparing the average results of experiments Nos. 63 and 71 with those of Nos. 64 and 72. In the former case the losses with small pieces of lean beef round averaged, water 27.83, protein 9.54, fat 2.09, and ash 46.37 per cent. In the latter case, when larger pieces of similar meat were cooked, the broth contained, on an average, water 25.24, protein 7.83, fat 1.94, and ash 34.63 per cent of the quantities originally present in the meat. Thus it seems fair to conclude that, the other conditions being uniform, the larger the piece of meat the smaller relatively are the losses which result when the meat is cooked in hot or boiling water.

The effect of the kind of meat upon the losses which result when it is cooked in hot water may be seen by the average results of tests made under uniform conditions with beef, veal, mutton, and pork. Thus, in experiments Nos. 10, 10a, 29, 29a, 30, and 30a the average amounts of nutrients recovered in the broth, when medium fat beef round was cooked were, water 53.46, protein 7.45, fat 22.53, and ash 49.35 per cent. In the case of veal (Nos. 38, 38a, 40, and 40a) the average losses were, water 35.99, protein 7.52, fat 5.74, and ash 31.67 per cent. In the case of mutton (Nos. 39, 39a, 41, and 41a) the average losses were, water 43.92, protein 8.00, fat 32.62, and ash 40.39 per cent; and in the case of pork, i. e., fresh ham (Nos. 36, 36a, 37, and 37a) the average losses were, water 39.99, protein 5.97, fat 6.22, and ash 33.89 per cent.

As will be seen, the total number of experiments available for considering the relative losses when different kinds of meat are cooked under uniform conditions is small, and sweeping general deductions are therefore not advisable. Judging by the available data, however, it appears that the amount of water and mineral matter removed in the broth is considerably larger with beef than with veal, mutton, and pork. With the exception of protein, the losses which veal sustains when cooked in hot or boiling water are low as compared with the other lean meats. In the case of mutton, the amount of fat removed in the broth was high as compared with the beef, pork, and veal cooked under the same conditions. The amount of fat removed in the case of pork was comparatively small, although the pork used was much fatter than the other meats.

It is possible, from the results of the tests summarized in Table 39, to compare the losses observed when different cuts of the same kind of meat are cooked in hot or boiling water under uniform conditions. Thus, in the case of medium fat beef round (Nos. 10, 10a, 29, 29a, 30, and 30a) the average losses were, water 53.46, protein 7.45, fat 22.53, and ash 49.41 per cent. In the case of very fat "plate boil" beef (Nos. 32 and 32a) the average losses were, water 37.50, protein 6.18, fat 15.00, and ash 36.65 per cent. In the case of very fat beef neck (Nos. 33 and 33a) the average losses were, water 26.30, protein 4.16, fat 2.70, and ash 22.55; and in the case of very fat beef ribs (Nos. 34 and 34a) the average losses were, water 34.41, protein 5.20, fat 11.36, and ash 32.50 per cent.

In the above-mentioned tests the meat was cooked for ten minutes at a temperature of 100° C. and then for three hours at a temperature of 80° to 85° C. The quantity of meat used varied somewhat, but in no case were the pieces very small. It should be stated, further, that the different cuts were not from the same animal. As will be seen, the medium fat beef round lost considerably more water, protein, and ash than the other cuts. The smallest losses were observed with the very fat beef neck. With the exception of fat, the losses observed with the very fat "plate boil" were somewhat less than those with medium fat beef round. However, with the former the losses were much greater than with the very fat beef neck, and somewhat greater than with the very fat beef rib.

Although the number of experiments is not sufficient for final conclusions, it seems fair to say that different cuts of the same kind of meat vary considerably as regards the amount and nature of the losses sustained when cooked in hot water. It is the intention to continue this line of investigation, using different cuts from the same animal.

EXPERIMENTS WITH MEATS COOKED BY PANBROILING.

Three experiments were made to determine the losses and changes resulting from the panbroiling of meats. The method followed, which was the same as that described in a report of previous investigations of this nature,[a] was in brief as follows: The meat was freed from bone and gristle and then passed two or three times through a sausage mill, the finely divided meat being intimately mixed after each grinding. The ground meat was then made into cakes weighing 60 to 80 grams each, several of which were reserved for analysis in the uncooked state. The remainder were weighed and then carefully cooked by panbroiling—that is, upon the surface of a medium hot, dry, cast-iron frying pan, without the addition of fat either before or during the process. The cakes of meat were well seared on both sides, and were then frequently turned during the cooking, which in each of these experiments was carried on over a gas flame for fifteen minutes. The meat was then removed from the frying pan, care being taken to scrape off, as completely as possible, any material adhering to the pan. The cooked meat was then weighed and prepared for analysis in the usual way.

The difference in the weight of the raw and cooked meat showed the total loss resulting from cooking, and the difference between the amount of each ingredient of the uncooked meat and that of the cooked meat was assumed to represent the loss of such ingredient during cooking. In the tables a loss is indicated by the minus sign (—). It will be observed that in some cases there appears to be a gain indicated by a plus sign (+). This apparent anomaly is explained in the discussion of the results following the summary below.

Tables 40–42 and the accompanying text give the data of the experiments on the effects of panbroiling.

COOKING EXPERIMENT NO. 46.

The meat used in this experiment consisted of lean beef round from an animal about 2½ years old. The losses in weight during the two tests were as follows:

First test:		
Weight of meat before cooking	grams	343.09
Weight of meat after cooking	do	232.48
Loss in weight in cooking	do	110.61
Loss in weight in cooking	per cent	32.24
Second test:		
Weight of meat before cooking	grams	348.65
Weight of meat after cooking	do	265.85
Loss in weight in cooking	do	118.80
Loss in weight in cooking	per cent	30.89

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 102, p. 16.

The effect of cooking upon the quantities of nutrients is shown in the following table:

TABLE 40.—*Results of cooking (panbroiling) experiment No. 46.*

	First test.					Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In uncooked meat	1202	264.73	70.25	5.59	3.67	1202	296.87	78.78	6.27	4.11
In cooked meat	1203a	155.83	68.21	5.63	3.37	1203b	178.20	78.00	6.43	3.85
Lost (−) or (apparently) gained (+)	.....	−108.90	−2.04	+ .04	− .30	.....	−118.67	− .78	+ .16	− .26
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	1203a	58.86	97.10	100.00	91.83	1203b	60.03	99.01	100.00	93.45
Lost (−) or (apparently) gained (+)	1203a	− 41.14	−2.90	+ .71	−8.17	1203b	− 39.97	− .99	+2.55	−6.55
Lost (−) or gained (+) in percentages of the weight of uncooked meat	.....	− 31.74	− .59	+ .01	− .09	.....	− 30.85	− .20	+ .04	− .07

COOKING EXPERIMENT NO. 49.

The meat used in this experiment was lean beef round from an animal about 3 years old. The losses in weight resulting from the cooking of the meat were as follows:

First test:

Weight of meat before cooking	grams	256.54
Weight of meat after cooking	do	196.16
Loss in weight in cooking	do	60.38
Loss in weight in cooking	per cent	23.54

Second test:

Weight of meat before cooking	grams	270.02
Weight of meat after cooking	do	190.77
Loss in weight in cooking	do	79.25
Loss in weight in cooking	per cent	29.35

The effect of cooking upon the nutrients of the meat is shown by the data in the following table:

TABLE 41.—*Results of cooking (panbroiling) experiment No. 49.*

	First test.					Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In uncooked meat	1210	197.18	53.62	3.82	2.31	1210	207.54	56.43	4.02	2.43
In cooked meat	1213	137.29	52.73	4.41	2.47	1214	129.43	55.42	4.60	2.56
Lost (−) or (apparently) gained (+)	.....	−59.89	− .89	+ .59	+ .16	.....	−78.11	−1.01	+ .58	+ .13
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	1213	69.63	98.34	100.00	100.00	1214	62.36	98.21	100.00	100.00
Lost (−) or (apparently) gained (+)	1213	−30.37	−1.66	+15.44	+7.00	1214	−37.64	−1.79	+14.43	+5.35
Lost (−) or gained (+) in percentages of weight of uncooked meat	.....	−23.35	− .35	+ .23	+ .06	.....	−21.09	− .37	+ .22	+ .05

COOKING EXPERIMENT NO. 52.

The meat in this experiment was lean beef round from an animal about 3 years old. The losses in weight due to cooking were as follows:

First test:

Weight of meat before cooking	grams	246.35
Weight of meat after cooking	do	187.58
Loss in weight in cooking	do	58.77
Loss in weight in cooking	per cent	23.86

Second test:

Weight of meat before cooking	grams	231.18
Weight of meat after cooking	do	175.96
Loss in weight in cooking	do	55.22
Loss in weight in cooking	per cent	23.89

The data of Table 42 shows the effects of cooking upon the nutrients of the meat:

TABLE 42.—*Results of cooking (panbroiling) experiment No. 52.*

	First test.					Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In uncooked meat	1235	190.16	51.73	2.61	2.24	1235	178.45	48.55	2.45	2.10
In cooked meat	1236	131.48	51.04	2.96	2.59	1237	123.52	47.81	2.81	2.39
Lost (−) or (apparently) gained (+)	.....	−58.68	− .69	+ .35	+ .35	.....	−54.93	− .74	+ .36	+ .29
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
In cooked meat	1236	69.14	98.67	100.00	100.00	1237	69.22	98.48	100.00	100.00
Lost (−) or (apparently) gained (+)	1236	−30.86	−1.33	+13.41	+15.62	1237	−30.78	−1.52	+14.70	+13.81
Lost (−) or gained (+) in percentages of the weight of uncooked meat	.....	−23.82	− .28	+ .14	+ .14	.....	−23.76	− .32	+ .13	+ .12

SUMMARY OF RESULTS OF EXPERIMENTS IN PANBROILING.

The results of the three experiments on panbroiling are summarized in the following table, which also contains, for the purpose of comparison, the results of similar experiments previously reported:[a]

TABLE 43.—*Summary of the losses resulting in the cooking of beef by the method of panbroiling.*

Cooking experiment No.	Laboratory No.	Lean beef round.	Percentage of fat.	Total loss and loss of each nutrient expressed in percentages of the weight of the uncooked meat.					Loss of nutrients expressed in percentages of total amounts in uncooked meat.			
				Total weight.	Water.	Protein.	Fat.	Ash.	Water.	Protein.	Fat.	Ash.
			P. ct.	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*	*P. ct.*
46	1203a	Panbroiled, 15 minutes	2.42	−32.24	−31.74	−0.59	+0.01	−0.09	−41.14	−2.90	+ 0.71	− 8.17
46	1203b	do	2.42	−30.89	−30.85	− .20	+ .04	− .07	−39.97	− .99	+ 2.55	− 6.55
49	1213	do	2.25	−23.54	−23.35	− .35	+ .23	+ .06	−30.37	−1.66	+15.44	+ 7.00
49	1214	do	2.41	−29.35	−21.09	− .37	+ .22	+ .05	−37.64	−1.79	+14.43	+ 5.35
52	1236	do	1.58	−23.86	−23.82	− .28	+ .14	+ .14	−30.78	−1.52	+13.41	+15.62
52	1237	do	1.60	−23.89	−23.76	− .32	+ .13	+ .12	−30.37	−1.66	+14.70	+13.81
		Average of 6 tests	2.11	−27.30	−25.77	− .35	+ .13	+ .04	−35.05	−1.75	+10.21	+ 4.51
1	399	Panbroiled, 15 minutes	3.44	−28.50	−28.50	+ .30	− .05	− .10	−38.10	+1.30	− .63	− 6.70
12	497	do	2.59	−33.00	−31.20	−1.60	t	− .10	−41.60	−7.40	+ 1.50	− 9.30
12	498	do	2.56	−31.40	−31.20	− .20	t	− .10	−41.50	−1.10	t	− 7.30
		Average of 3 tests	2.86	−30.97	−30.30	− .50	− .05	− .10	−40.40	−2.40	+ .29	− 7.80
		Average of 9 tests	2.49	−29.14	−28.04	− .43	+ .04	− .03	−37.73	−2.08	+ 5.25	− 1.65
2	408	Panbroiled, 17 minutes	4.70	−23.10	−24.50	+1.40	+ .10	t	−33.70	+6.20	+ 2.40	+ 3.80
2	409	do	4.68	−24.10	−25.10	+ .70	+ .10	− .10	−34.10	+3.30	+ 2.40	−11.10
3	416	do	3.60	−33.50	−33.30	− .20	+ .20	− .10	−44.60	− .90	+ 8.70	− 8.30
3	417	do	3.06	−30.50	−30.40	+ .10	+ .23	− .00	−40.70	+ .20	+11.23	− .00
		Average of 4 tests	4.01	−27.80	−28.33	+ .50	+ .16	− .05	−38.28	+2.20	+ 6.18	− 3.90
1	398	Panbroiled, 20 minutes	3.93	−35.10	−35.20	+ .40	+ .10	− .10	−46.80	+2.10	+ 2.80	−11.80
		Average of 14 tests	3.48	−30.68	−30.52	+ .16	+ .10	− .06	−40.94	+ .74	+ 4.74	− 5.78

t=trace, less than 0.01 per cent. +=apparent gain.

The total loss in weight resulting from panbroiling in the individual tests here reported varied from 23.10 to 35.10 per cent, the average of all the experiments being 30.68 per cent, and was due almost entirely to the removal of water, the average loss of this constituent being 30.52 per cent. In the first six tests, summarized in Table 43, which are the more recent of the investigations with this method of cooking, a small loss of nitrogenous matter was noted in all cases. In the remainder of the tests, i. e., those previously reported, an apparent gain in nitrogenous matter was noted in some cases. With one exception there was apparently a gain in the amount of fat in all cases, although it is plainly evident that cooking according to this method

[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 102.

could not add any nutritive material to the meat. It is difficult at present to account for this apparent gain in nitrogenous matter or fat. A possible explanation which suggests itself is that during the cooking chemical changes take place in which products soluble in ether are produced by the cleavage of protein or otherwise, and experiments have been undertaken in connection with these investigations with the object of demonstrating whether or not changes of this nature are brought about. The results of the tests reported above show that there is a loss of mineral matter in some cases and an apparent gain in others, a discrepancy without doubt due to unavoidable errors in the method of determining the ash in the uncooked and cooked meats, since it is evident that a very slight error in the determination of the ash makes a considerable difference in the results expressed in percentages.

Although the results obtained in studying the losses occurring when meat is cooked by panbroiling are not as yet satisfactory or final, the average of the fourteen tests here reported indicates plainly that the percentage loss of nutritive material is inconsiderable as compared with the losses resulting in roasting, boiling, and frying.

EXPERIMENTS WITH MEAT COOKED BY SAUTÉING.

The method followed in the experiments with meats cooked by sautéing was very similar to that in the pan-broiling experiments. The meat was prepared by first freeing it from bone and gristle and grinding it several times in a sausage mill, with intimate mixing of the meat after each grinding. The homogeneous mixture was then made into cakes weighing about 75 grams each, like those commonly known as Hamburg steak. A number of these were reserved for analysis in the uncooked state, the remainder being cooked as follows: A weighed quantity of lard, sufficient to form a thin layer on the bottom of the frying pan, was heated until smoking hot; the cakes of meat were then placed in the pan and cooked for fifteen minutes with frequent turning, after which they were removed, cooled, and weighed. A sample of the cooked meat was then prepared for analysis. Full analyses were also made of samples of the lard before and after cooking. The total loss in weight resulting from the cooking was found by subtracting the weight of the cooked meat from that of the uncooked meat. The loss or apparent gain in weight of nutrients due to cooking by this method was estimated in two ways: (1) By subtracting the weight of each nutrient in the cooked meat from that in the uncooked meat, and (2) from the analysis of the lard in which the meat was cooked, which of course contained such of the material cooked out of the meat as was not volatilized. The lard recovered after cooking is hereafter denoted "drippings."

The data of the experiments are given in the tables which follow:

COOKING EXPERIMENT NO. 47.

The meat used in this experiment was lean beef round from an animal about 2 years and 6 months old. The changes in weight by cooking were as follows:

First test:

Weight of meat before cooking	grams	285.44
Weight of meat after cooking	do	189.40
Loss in weight in cooking	do	96.04
Loss in weight in cooking	per cent	33.65

Second test:

Weight of meat before cooking	grams	236.87
Weight of meat after cooking	do	148.44
Loss in weight in cooking	do	88.43
Loss in weight in cooking	per cent	37.33

In the first test 89.1 grams of lard were used for cooking; the amount recovered after cooking, including material cooked out of the meat, was 82.44 grams. In the second test the weights of lard were 116.31 grams before cooking and 108.35 grams after cooking.

The gains or losses of nutrients due to cooking the meat are given in the following table:

TABLE 44.—*Results of cooking (sautéing) experiment No. 47.*

	First test.					Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In uncooked meat	1202	220.30	58.46	4.65	3.05	1202	182.82	48.51	3.86	2.53
In cooked meat	1204a	113.34	60.63	14.03	2.52	1202b	88.83	47.52	11.00	1.99
Lost (−) or gained (+) in cooking	.....	−106.96	+2.17	+ 9.38	− .53	.....	− 93.99	− .99	+ 7.14	− .54
In lard before cooking	1262	.40	None.	88.70	None.	1262	.52	None.	115.79	None.
In lard after cooking (drippings)	.....	None.	1.70	80.72	.02	1262	None.	1.47	106.86	.02
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Lost (−) or gained (+), calculated from analyses of cooked and uncooked meat	1204a	− 48.55	+3.71	+201.72	−17.38	1204b	− 51.39	−2.04	+184.97	−21.34
Lost (−), calculated from composition of drippings	.....	None.	−2.91	None.	− .66	.....	None.	−3.03	None.	− .79
Lost from lard used in cooking	1262	100.00	None.	None.	None.	1262	100.00	None.	.54	None.
Lost or gained, in percentage of uncooked meat	.....	− 37.47	+ .76	+ 3.28	− .19	.....	− 39.66	− .42	+ 3.01	− .23
In drippings, in percentage of weight of uncooked meat	.....	None.	− .60	None.	− .01	.....	None.	− .62	None.	None.

COOKING EXPERIMENT NO. 50.

The meat used in this experiment was lean beef round from an animal about 3 years old. The changes in weight of meat due to cooking were as follows:

First test:

Weight of meat before cooking	grams	236.25
Weight of meat after cooking	do	174.48
Loss in weight in cooking	do	61.77
Loss in weight in cooking	per cent	26.15

Second test:

Weight of meat before cooking	grams	239.47
Weight of meat after cooking	do	166.96
Loss in weight in cooking	do	72.51
Loss in weight in cooking	per cent	30.28

The weight of lard used for cooking was 95.03 grams in the first test and 104.18 grams in the second. The amount recovered was 82.82 grams in the first test and 95.61 grams in the second.

The gains or losses of nutrients due to cooking are given in the following table:

TABLE 45.—*Results of cooking (sautéing) experiment No. 50.*

	First test.					Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In uncooked meat	1210	181.58	49.38	3.52	2.13	1210	184.06	50.05	3.57	2.15
In cooked meat	1217	108.14	48.72	15.76	2.11	1218	103.15	49.39	12.42	2.07
Lost(−)or gained (+) in cooking	.....	−73.44	− .66	+ 12.24	−0.02	.....	−80.91	− .66	+ 8.85	− .08
In lard before cooking	1262	.43	None.	94.60	None.	1262	.47	None.	103.71	None.
In lard after cooking (drippings)	.....	.12	.98	91.72	None.	.....	None.	1.25	94.32	.03
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Lost(−)or gained (+), calculated from analyses of cooked and uncooked meat	1217	−40.44	−1.34	+347.73	− .90	1218	−43.96	−1.32	+196.91	−3.72
Lost (−), calculated from composition of drippings	.....	None.	−1.98	None.	None.	.....	None.	−2.50	None.	−2.78
Lost from lard used in cooking	1262	72.09	None.	.68	None.	1262	100.00	None.	.52	None.
Lost or gained, in percentage of weight of uncooked meat	1217	−38.31	− .28	+ 5.18	− .01	1218	−33.79	− .28	+ 3.70	− .03
In drippings, in percentage of weight of uncooked meat	.....	None.	− .41	None.	None.	.....	None.	− .52	None.	− .01

COOKING EXPERIMENT NO. 53.

The meat used in this experiment was lean beef round from an animal about 3 years old. The changes in weight of meat due to cooking were as follows:

First test:		
Weight of meat before cooking	grams	211.92
Weight of meat after cooking	do	142.07
Loss in weight in cooking	do	69.85
Loss in weight in cooking	per cent	32.96
Second test:		
Weight of meat before cooking	grams	201.63
Weight of meat after cooking	do	128.43
Loss in weight in cooking	do	73.20
Loss in weight in cooking	per cent	36.30

The lard used in the first test weighed 67.33 grams before cooking and 61.87 grams after cooking; in the second test the weights were respectively 106.68 grams and 100.87 grams.

The following table gives the data regarding the gains or losses of nutrients during cooking:

TABLE 46.—*Results of cooking (sautéing) experiment No. 53.*

	First test.					Second test.				
	Laboratory No.	Water.	Protein.	Fat.	Ash.	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In uncooked meat	1235	163.58	44.50	2.25	1.93	1235	155.64	42.34	2.14	1.83
In cooked meat	1239	89.34	43.99	6.96	2.19	1240	79.16	40.58	7.26	2.04
Lost (−) or gained (+) in cooking	.....	− 74.24	− .51	+ 4.71	+ .26	.....	− 76.48	− 1.76	+ 5.12	+ .21
In lard before cooking	1263	.15	None.	67.18	None.	1263	.25	None.	106.43	None.
In lard after cooking (drippings)	.....	None.	.26	61.61	None.	.....	None.	.31	100.55	.01
Proportion of nutrients:		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*		*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Lost (−) or gained (+), calculated from analyses of cooked and uncooked meat	1639	− 47.70	− 1.15	+209.33	+13.47	1240	− 49.14	− 4.16	+239.25	+11.48
Lost (−), calculated from composition of drippings	.....	None.	− .58	None.	− .55	.....	None.	− .73	None.	None.
Lost from lard used in cooking	1263	100.00	None.	1.28	None.	1263	100.00	None.	.71	None.
Lost or gained, in percentage of weight of uncooked meat	1239	− 36.82	− .24	+ 2.22	+ .12	1240	− 37.92	− .94	+ 2.53	+ .10
In drippings, in percentage of weight of uncooked meat	.....	None.	− .12	None.	None.	.....	None.	− .05	None.	None.

SUMMARY OF RESULTS OF THE SAUTÉING EXPERIMENTS.

A summary of the results obtained in the experiments in which meat was cooked by sautéing is given in the following table, which includes the data concerning the kind of meat used, the time of cooking, and the apparent losses or gains of the different nutrients expressed in percentages of the total amounts of the corresponding nutrients in the uncooked meat and in percentages of the total quantity of meat cooked.

TABLE 47.—*Summary of the losses resulting in the cooking of beef by the method of sautéing.*

Cooking experiment No.	Laboratory No.	Lean beef round.	Percentage of fat.	Loss of each nutrient expressed in percentages of the weight of the uncooked meat.				Loss of nutrients expressed in percentages of total amounts in uncooked meat			
				Water.	Protein.	Fat.	Ash.	Water.	Protein.	Fat.	Ash.
			Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
47	1204a	Sautéed 15 minutes..	7.41	−37.47	−0.60[a]	+3.28	−0.19	−48.55	−2.91[a]	+201.72	−17.38
47	1204b	.....do.....	7.41	−39.66	− .42	+3.01	− .23	−51.39	−2.04	+184.97	−21.34
50	1217	.....do.....	9.03	−33.31	− .28	+5.18	− .01	−40.44	−1.34	+347.73	− 0.90
50	1218	.....do.....	7.44	−33.79	− .28	+3.70	− .03	−43.96	−1.32	+196.91	− 3.72
53	1239	.....do.....	4.90	−36.82	− .24	+2.22	+ .12	−47.70	−1.15	+209.33	+13.47
53	1240	.....do.....	5.65	−37.92	− .94	+2.53	+ .10	−49.14	−4.16	+239.25	+11.48
		Average.....	6.97	−36.50	− .46	+3.32	− .04	−46.86	−2.15	+229.99	− 3.07

[a] In this case the loss found from the analysis of the drippings was used in this table. In all other cases the loss (−) or gain (+) of nutrients calculated from the analyses of the cooked and uncooked meats was used.

While the number of experiments here reported is not sufficient to warrant definite conclusions as to the extent and nature of the losses and changes resulting in this process of cooking, some deductions seem possible.

It is evident from the data reported that a considerable loss in weight results by this method of cooking and that this loss in weight is due chiefly to the evaporation of water. However, in all instances a small loss of nitrogenous matter and usually of mineral constituents was also observed. On the other hand, as was to be expected, a decided gain in fat was noted; in other words, when cooked in a small amount of hot fat, the meat absorbs a considerable proportion of the fat.

The amount of water driven off by heat varied from 40.44 to 51.39 per cent, averaging 46.86 per cent of the entire amount contained in the original uncooked meat. The nitrogenous matter lost during cooking varied from 1.15 to 4.16 per cent, the average in the six tests being 2.15 per cent of the amount contained in the original uncooked meat. As regards the fat, in one case the actual weight of this constituent in the cooked meat was more than three times as much as that contained in the uncooked meat. The average increase in fat in the six tests was 229.99 per cent of the quantity contained in the meat before cooking.

LOSSES AND CHANGES IN MEATS COOKED BY ROASTING.

In order to determine the influence of roasting upon the character and amount of the losses and upon the chemical composition and nutritive value of meat, the following method was used in a number of experiments reported beyond, which are, however, regarded as preliminary. The meat was carefully trimmed without removing the bone, and prepared for the oven, as is commonly done by the housewife. It was then weighed, placed upon the rack of a roasting pan, and cooked for the required time in a gas oven at a given temperature. When sufficiently cooked, it was removed from the oven and weighed while still warm. The drippings were also weighed. The cooked meat was immediately placed in a large glass jar, which was closed air-tight to prevent a loss of water, and set aside until the meat acquired the temperature of the laboratory. The bone in the cooked meat was separated from the edible portion and weighed, but the amounts of water and nutrients in the bone were not determined. The edible portion of the meat was passed through a sausage mill two or three times and thoroughly mixed each time. Samples were prepared for analysis and analyzed by the usual methods. The weighed drippings were also analyzed by the methods given earlier in this bulletin.

The total loss in weight occurring in the roasting was ascertained by subtracting the weight of the cooked from that of the uncooked meat. The weight of the drippings was subtracted from the total loss in weight, the difference thus obtained being taken as the amount of volatile matter removed during cooking. It is practically certain that this volatile matter consisted very largely of water, although there are other substances driven off by the dry heat of roasting or baking. So far as the authors have been able to learn, the nature of these volatile products is unknown. It is proposed to study their amount and character in the near future in connection with these investigations.

The fact that the bone was left in the meat during roasting introduces a factor which must be taken into account in considering the losses which the bone itself undergoes. The amount of water left in the bone after cooking was not determined. That it does lose much water we have proved experimentally, the amount being indeed so large that it is impossible to calculate the amount of water in the uncooked meat from the usual analytical data.

So far no experiments have been made in connection with these investigations to find out whether or not the bone loses fat, nitrogenous matter, or mineral matter during cooking, but it is hoped that the question may soon be studied. It has been assumed for the time being that the bone loses no considerable amount of these constituents in the process of roasting.

The results of the roasting experiments are given below, the object of the experiment, the kind and amount of meat used, the method and time of cooking, and the losses in weight being recorded in detail.

COOKING EXPERIMENT NO. 75.

The meat used in this experiment was fresh pork, consisting of a right ham from a Duroc-Jersey hog (barrow), 8½ months old, which had been fattened on corn. The entire ham was placed in a covered roasting pan and cooked in a gas-heated oven for three hours and forty-five minutes, the temperature of the oven for the first fifteen minutes being 249° C. (480° F.), then 193° C. (380° F.) for two hours, and 160° C. (320° F.) for an hour and a half longer. The time employed for cooking averaged twenty-five minutes for each pound of meat.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	4,124.84
Weight of meat after cooking	do	2,927.08
Loss in weight in cooking	do	1,197.76
Loss in weight in cooking	per cent	29.04
Weight of edible meat	grams	2,551.54

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 48.—*Results of cooking (roasting) experiment No. 75.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1483	1,361.70	586.83	596.53	26.02
In drippings and volatile matter	1483	871.73	10.48	312.37	3.18
In uncooked meat	1483a	.....	597.31	908.90	29.20
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat	.....	.....	98.25	65.63	89.11
In drippings and volatile matter	.....	.....	1.75	34.37	10.89
In drippings on basis of total weight of uncooked meat	.....	21.13	.25	7.57	.08

COOKING EXPERIMENT NO. 76.

The object of this experiment was to determine the losses resulting when fresh pork is roasted at a rather low temperature for a considerable length of time. The meat used consisted of a right ham from a Duroc-Jersey hog (barrow), 8½ months old, which had been fattened on corn. The entire ham was placed in an open roasting pan and cooked at a low temperature for five hours and forty minutes. The temperature of the oven was 232° C. (450° F.) for the first fifteen minutes; it was then allowed to drop, and the cooking continued for five hours and twenty-five minutes at 143°–138° C. (290°–280° F.), the full time of cooking averaging forty-two minutes for each pound of meat. The cooked meat was very light brown, somewhat underdone, but very juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	3,642.90
Weight of meat after cooking	do	2,962.19
Loss in weight in cooking	do	680.71
Loss in weight in cooking	per cent	18.69
Weight of edible meat	grams	2,607.02

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 49.—*Results of cooking (roasting) experiment No. 76.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1484	1,494.42	496.46	945.53	23.40
In drippings and volatile matter	1484	609.50	9.09	286.01	2.58
In uncooked meat	1484a		505.55	1,231.54	25.98
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			95.20	76.77	90.07
In drippings and volatile matter			1.80	23.23	9.93
In drippings on basis of total weight of uncooked meat		16.73	.25	7.85	.07

COOKING EXPERIMENT NO. 77.

The fresh pork used in this experiment consisted of a right ham from a Duroc-Jersey hog (sow), 8½ months old, which had been fattened on corn. The entire ham was placed in an open roasting pan and cooked for three hours and forty-five minutes, or an average of twenty-five minutes for each pound of meat. The meat was basted every fifteen minutes during the roasting. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, 193° C. (380° F.) for the next two hours, and 160° C. (320° F.) for an hour and a half longer. The cooked meat was well done and juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	4,060.06
Weight of meat after cooking	do	2,927.08
Loss in weight in cooking	do	1,132.98
Loss in weight in cooking	per cent	27.91
Weight of edible meat	grams	2,579.93

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 50.—*Results of cooking (roasting) experiment No. 77.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1486	1,327.57	561.88	683.90	22.70
In drippings and volatile matter	1486	636.86	14.01	478.25	3.86
In uncooked meat	1486a		575.89	1,162.15	26.56
Proportions of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			97.57	58.85	85.47
In drippings and volatile matter			2.43	41.15	14.53
In drippings on basis of total weight of uncooked meat		15.69	.34	11.78	.10

COOKING EXPERIMENT NO. 78.

The fresh pork used in this experiment was a right ham from a Duroc-Jersey hog (sow), 8½ months old, which had been fattened for market on hominy and gluten meal. The entire ham was placed in an open roasting pan and roasted for three hours and thirty minutes. The temperature of the oven during the first fifteen minutes was 249° C. (480° F.), for the next two hours it was kept at 193° C. (380° F.), and for an hour and fifteen minutes longer at 160° C. (320° F.), the time of cooking averaging twenty-five minutes for each pound. The cooked meat was well done, very juicy, and brown, but not hard.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	3,940.57
Weight of meat after cooking	do	2,692.20
Loss in weight in cooking	do	1,248.37
Loss in weight in cooking	per cent	31.68
Weight of edible meat	grams	2,327.68

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 51.—*Results of cooking (roasting) experiment No. 78.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1489	1,121.13	498.54	693.58	21.18
In drippings and volatile matter	1489	681.38	14.49	548.11	4.39
In uncooked meat	1489a		513.03	1,241.69	25.57
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			97.18	55.86	82.83
In drippings and volatile matter			2.82	44.14	17.17
In drippings on basis of total weight of uncooked meat		17.29	.37	13.91	.11

COOKING EXPERIMENT NO. 79.

The object of this experiment was to determine the losses resulting from roasting fresh pork at a high temperature for a rather long time. The meat selected was a right ham from a Duroc-Jersey hog (barrow) 8½ months old, which had been fattened for market on hominy and gluten meal. The entire ham was placed in a covered roasting pan and cooked for four hours and fifteen minutes. The temperature of the oven for the first fifteen minutes was 260° C. (500° F.); it was then continued four hours longer at 193° C. (380° F.). The time allowed for cooking averaged thirty minutes for each pound of meat, which, when done, was dry and overcooked. The fat was well browned and the lean was exposed in several places.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams..	3,742.12
Weight of meat after cooking	do....	2,012.81
Loss in weight in cooking	do....	1,729.31
Loss in weight in cooking	per cent..	46.21
Weight of edible meat	grams..	1,707.47

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 52.—*Results of cooking (roasting) experiment No. 79.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1491	703.44	497.70	505.89	16.90
In drippings and volatile matter	1491	1,027.66	13.90	683.70	4.05
In uncooked meat	1491a		511.60	1,189.59	20.95
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			97.28	42.51	80.67
In drippings and volatile matter			2.72	57.49	19.33
In drippings on basis of total weight of uncooked meat		27.46	.37	18.27	.11

COOKING EXPERIMENT NO. 80.

The object of this experiment was to determine the effect of roasting fresh pork for a rather short time. The meat used consisted of a right ham from a Duroc-Jersey hog (barrow) 8½ months old, which had been fattened for market on hominy, gluten meal, etc. The entire ham was placed in an open roasting pan and cooked for an hour and forty minutes, the temperature of the oven for the first fifteen minutes being 249° C. (480° F.), and for an hour and twenty-five minutes longer 193° C. (380° F.). The total time of cooking averaged twenty-five minutes for each pound of meat. The cooked meat was well browned and very juicy, but somewhat underdone.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams..	1,842.71
Weight of meat after cooking	do....	1,431.65
Loss in weight in cooking	do....	411.06
Loss in weight in cooking	per cent..	22.30
Weight of edible meat	grams..	1,221.63

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 53.—*Results of cooking (roasting) experiment No. 80.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1493	630.46	231.98	351.57	10.63
In drippings and volatile matter	1493	248.05	3.15	159.01	.85
In uncooked meat	1493a		235.13	510.58	11.48
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			98.66	68.86	92.60
In drippings and volatile matter			1.34	31.14	7.40
In drippings on basis of total weight of uncooked meat		13.46	.17	8.63	.05

COOKING EXPERIMENT NO. 81.

The meat used in this experiment consisted of a right ham from a Duroc-Jersey hog (sow) 9 months old, which had been fattened for market on corn and clover hay, the ham skin being removed before cooking. The meat was roasted in an open pan for two hours and fifty-five minutes, the temperature of the oven being 238° C. (460° F.) for the first fifteen minutes and 193° C. (380° F.) for two hours and forty minutes longer. The time of cooking averaged twenty-five minutes per pound.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams..	4,266.59
Weight of meat after cooking	do....	3,167.05
Loss in weight in cooking	do....	1,099.54
Loss in weight in cooking	per cent..	25.77
Weight of edible meat	grams..	2,852.88

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 54.—*Results of cooking (roasting) experiment No. 81.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1504	1,461.19	540.60	838.43	27.39
In drippings and volatile matter	1504	575.07	4.67	517.97	1.83
In uncooked meat	1504a		545.27	1,356.40	29.22
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			99.14	61.81	93.74
In drippings and volatile matter			.86	38.19	6.26
In drippings on basis of total weight of uncooked meat		13.50	.11	12.14	.04

COOKING EXPERIMENT NO. 82.

The meat used in this experiment was a right ham from a Duroc-Jersey hog (sow) 8½ months old, which had been fattened for market on corn and clover hay. The ham, with the skin removed, was placed in an open roasting pan and cooked for three hours and forty-five minutes, the temperature of the oven for the first fifteen minutes being 249° C. (480° F.); then for two hours it was kept at 193° C. (380° F.), and for an hour and a half longer at 160° C. (320° F.). The total time of cooking averaged twenty-five minutes to the pound. The cooked meat was juicy and very well done.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams..	4,052.97
Weight of meat after cooking	do....	2,643.59
Loss in weight in cooking	do....	1,409.38
Loss in weight in cooking	per cent..	34.77
Weight of edible meat	grams..	2,336.93

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 55.—*Results of cooking (roasting) experiment No. 82.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1506	1,153.94	552.20	615.99	25.24
In drippings and volatile matter	1506	913.26	16.49	474.53	5.10
In uncooked meat	1506a		568.69	1,090.52	30.34
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			97.11	56.49	83.19
In drippings and volatile matter			2.89	43.51	16.81
In drippings on basis of total weight of uncooked meat		22.53	.40	11.71	.13

COOKING EXPERIMENT NO. 83.

The meat used in this experiment consisted of a right ham from a Duroc-Jersey hog (sow) about nine months old, which had been fattened for market on corn and clover hay. The skin was removed from the ham before cooking. The meat was then placed in an open roasting pan and cooked for three hours and forty-five minutes, being basted every fifteen minutes. During the first fifteen minutes the temperature of the oven was 249° C. (480° F.); it was then kept at 193° C. (380° F.) for two hours, and at 160° C. (320° F.) for an hour and a half longer. The time of cooking averaged twenty-five minutes per pound. The meat was well done, evenly cooked, and juicy on the surface.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams..	3,961.83
Weight of meat after cooking	do....	2,671.94
Loss in weight in cooking	do....	1,289.89
Loss in weight in cooking	per cent..	32.55
Weight of edible meat	grams..	2,388.45

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 56.—*Results of cooking (roasting) experiment No. 83.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1511	1,316.66	559.82	506.32	26.03
In drippings and volatile matter	1511	786.69	10.93	488.33	3.72
In uncooked meat	1511a		570.75	994.65	29.75
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			98.09	50.92	87.50
In drippings and volatile matter			1.91	49.08	12.50
In drippings on basis of total weight of uncooked meat		19.86	.28	12.33	.09

COOKING EXPERIMENT NO. 84.

The meat used in this experiment was the right fifth rib from a 4-year-old Aberdeen-Angus steer, fed on blue-grass pasture, corn, clover hay, and some supplementary nitrogenous feed. The entire rib was placed in an open roasting pan and cooked for one hour and twenty-five minutes. The temperature of the oven for the first fifteen minutes was 249° C. (480° F.). For the remaining one hour and ten minutes it was kept as near 193° C. (380° F.) as possible. The time employed for the roasting averaged 20.1 minutes to the pound. The cooked meat was somewhat tough and dry. There was a small quantity of red-brown juice in the pan.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	1,895.84
Weight of meat after cooking	do	1,421.01
Loss in weight in cooking	do	474.83
Loss in weight in cooking	per cent	25.03
Weight of edible meat	grams	1,290.85

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 57.—*Results of cooking (roasting) experiment No. 84.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1536	522.61	254.66	511.12	11.75
In drippings and volatile matter	1536	290.55	1.59	181.98	.71
In uncooked meat	1536a		256.25	693.10	12.46
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			99.38	73.75	94.30
In drippings and volatile matter			.62	26.25	5.70
In drippings on basis of total weight of uncooked meat		15.33	.08	9.60	.04

COOKING EXPERIMENT NO. 85.

The meat used in this experiment was the left fourth rib from an old Aberdeen-Angus cow, fed on blue-grass pasture, corn, clover hay, and some supplementary nitrogenous feed. The entire rib was placed in an open roasting pan and cooked for one hour and twenty-five minutes. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes and 193° C. (380° F.) for one hour and ten minutes longer. The time employed for the roasting averaged 18.2 minutes to the pound. The center of the meat was medium well done, and there was a medium quantity of red juice.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	2,112.04
Weight of meat after cooking	do	1,750.58
Loss in weight in cooking	do	361.46
Loss in weight in cooking	per cent	17.11
Weight of edible meat	grams	1,603.01

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 58.—*Results of cooking (roasting) experiment No. 85.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1537	761.55	323.15	514.22	14.59
In drippings and volatile matter	1537	230.36	1.77	128.66	.67
In uncooked meat	1537a		324.92	642.88	15.26
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			99.45	79.99	95.61
In drippings and volatile matter			.55	20.01	4.39
In drippings on basis of total weight of uncooked meat		10.91	.08	6.09	.03

COOKING EXPERIMENT NO. 86.

The meat used in this experiment was the right fifth rib from a 4-year-old Shorthorn cow, fed on blue-grass pasture, corn, clover hay, and some supplementary nitrogenous feed. The entire rib was placed in an open roasting pan and cooked for one hour and twenty-five minutes. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes and 193° C. (380° F.) for one hour and ten minutes longer. The time employed for the cooking averaged 19.4 minutes to the pound. The cooked meat was well done, there was no pink color noticeable, and the juice was scanty and brown.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	1,963.20
Weight of meat after cooking	do	1,417.47
Loss in weight in cooking	do	545.73
Loss in weight in cooking	per cent	27.79
Weight of edible meat	grams	1,313.43

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 59.—*Results of cooking (roasting) experiment No. 86.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1538	432.64	207.26	674.05	9.46
In drippings and volatile matter	1538	301.23	.52	243.74	.24
In uncooked meat	1538a		207.78	917.79	9.70
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			99.75	73.44	97.53
In drippings and volatile matter			.25	26.56	2.47
In drippings on basis of total weight of uncooked meat		15.34	.03	12.42	.01

COOKING EXPERIMENT NO. 87.

The meat used in this experiment was the right fifth rib from a 4-year-old Aberdeen-Angus steer, fed on blue-grass pasture, corn, clover hay, and some supplementary nitrogenous feed. The entire rib was placed in an open roasting pan and cooked for one hour and fifteen minutes. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes and 193° C. (380° F.) for the remaining time. The time employed for the roasting averaged 18.2 minutes to the pound. The cooked meat seemed very satisfactory as judged by household standards. The outside was browned, the inside bright pink, and there was a medium quantity of red juice.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	1,856.89
Weight of meat after cooking	do	1,484.79
Loss in weight in cooking	do	372.10
Loss in weight in cooking	per cent	20.03
Weight of edible meat	grams	1,318.20

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 60.—*Results of cooking (roasting) experiment No. 87.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1539	828.94	235.80	241.74	10.54
In drippings and volatile matter	1539	219.73	.95	150.99	.43
In uncooked meat	1539a		236.75	392.73	10.97
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			99.60	61.55	96.09
In drippings and volatile matter			.40	38.45	3.91
In drippings on basis of total weight of uncooked meat		11.83	.05	8.13	.02

COOKING EXPERIMENT NO. 88

The meat used in this experiment was the right fifth rib from an aged Aberdeen-Angus cow, which had been fed on blue-grass pasture, corn, clover hay, and some supplementary nitrogenous feed. The entire rib was placed in an open roasting pan and cooked for one hour and fifteen minutes. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, and 193° C. (380° F.) for the remaining time. The time employed for the roasting averaged 18.2 minutes to the pound. The center of the meat was underdone or rare, and there was a considerable amount of red juice.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	1,856.89
Weight of meat after cooking	do	1,477.70
Loss in weight in cooking	do	379.19
Loss in weight in cooking	per cent	20.42
Weight of edible meat	grams	1,327.71

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 61.—*Results of cooking (roasting) experiment No. 88.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1540	745.99	251.54	321.63	11.81
In drippings and volatile matter	1540	276.44	1.25	100.99	.51
In uncooked meat	1540a	.....	252.79	422.62	12.32
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat	.....	.....	99.51	76.10	95.86
In drippings and volatile matter	.....	.....	.49	23.90	4.14
In drippings on basis of total weight of uncooked meat	.....	14.89	.06	5.44	.03

COOKING EXPERIMENT NO. 89.

The meat used in this experiment was fresh pork, consisting of a right ham from a Duroc-Jersey hog (sow), about 8 months old, which had been fattened for market on peas, oats, and barley. The entire ham was placed in an open roasting pan and cooked for four hours and fifteen minutes. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, 193° C. (380° F.) for two and one-half hours, and then 160° C. (320° F.) for an hour and a half longer. The time employed for cooking averaged twenty-five minutes to the pound. The meat was somewhat overcooked, and there was considerable juice.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	4,706.00
Weight of meat after cooking	do	3,104.27
Loss in weight in cooking	do	1,601.73
Loss in weight in cooking	per cent	34.03
Weight of edible meat	grams	2,805.33

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 62.—*Result of cooking (roasting) experiment No. 89.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible meat	1545	1,504.18	694.86	590.22	28.05
In drippings and volatile matter	1545	1,137.52	32.25	421.93	9.19
In uncooked meat	1545a	.....	727.11	1,012.15	37.24
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat	.....	.....	95.57	58.31	75.33
In drippings and volatile matter	.....	.....	4.43	41.69	24.67
In drippings on basis of total weight of uncooked meat	.....	24.17	.68	8.96	.19

COOKING EXPERIMENT NO. 90.

The meat used in this experiment was fresh pork, consisting of a right ham from a Yorkshire hog (barrow), which had been fattened for market on peas, oats, and barley. The entire ham was placed in an open roasting pan and cooked for four hours and a half. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, 193° C. (380° F.) for the next two hours, and 160° C. (320° F.) for two hours and fifteen minutes longer. The time employed for the cooking averaged 20.3 minutes to the pound. The meat was slightly undercooked in the upper round, and the center of the ham was very juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	6,013.61
Weight of meat after cooking	do	3,937.00
Loss in weight in cooking	do	2,076.61
Loss in weight in cooking	per cent	34.52
Weight of edible meat	grams	3,469.28

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 63.—*Results of cooking (roasting) experiment No. 90.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1558	1,945.08	920.31	593.08	37.48
In drippings and volatile matter	1558	1,442.30	25.54	599.86	8.89
In uncooked meat	1558a		945.85	1,192.94	46.37
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			97.30	49.71	80.83
In drippings and volatile matter			2.70	50.29	19.17
In drippings on basis of total weight of uncooked meat		23.98	.42	9.97	.14

COOKING EXPERIMENT NO. 91.

The meat used in this experiment was fresh pork, consisting of a right ham from a Duroc-Jersey hog (sow), about 9 months old, which had been fattened for market on peas, oats, and barley. The entire ham was placed in an open roasting pan and cooked for four hours. The temperature of the oven was 238° C. (460° F.) for the first fifteen minutes, 193° C. (380° F.) for the next two hours, and 160° C. (320° F.) for one hour and forty-five minutes longer. The time employed for the cooking averaged twenty-five minutes to the pound. The meat was well done and juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	4,294.94
Weight of meat after cooking	do	3,068.83
Loss in weight in cooking	do	1,226.11
Loss in weight in cooking	per cent	28.54
Weight of edible meat	grams	2,673.87

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 64.—*Results of cooking (roasting) experiment No. 91.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1559	1,580.72	627.53	464.16	27.27
In drippings and volatile matter	1559	850.47	15.68	354.49	4.55
In uncooked meat	1559a		643.21	818.65	31.82
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			97.56	56.70	85.71
In drippings and volatile matter			2.44	43.30	14.29
In drippings on basis of total weight of uncooked meat		19.89	.36	8.25	.11

COOKING EXPERIMENT NO. 92.

The meat used in this experiment was fresh pork, consisting of a ham from a Poland China hog, which had been fattened for market on barley. The entire ham was placed in an open roasting pan and cooked for four hours. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, 193° C. (380° F.) for one hour and forty-five minutes, and 160° C. (320° F.) for two hours longer. The time employed for the cooking averaged twenty-five minutes to the pound. The meat was juicy and well done.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	4,344.55
Weight of meat after cooking	do	2,909.34
Loss in weight in cooking	do	1,435.21
Loss in weight in cooking	per cent	33.03
Weight of edible meat	grams	2,591.64

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 65.—*Results of cooking (roasting) experiment No. 92.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1573	1,388.20	684.12	511.28	26.17
In drippings and volatile matter	1573	967.44	31.92	425.70	9.77
In uncooked meat	1573a		716.04	936.98	35.94
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			95.54	54.57	72.82
In drippings and volatile matter			4.46	45.43	27.18
In drippings on basis of total weight of uncooked meat		22.27	.73	9.79	.22

COOKING EXPERIMENT NO. 93.

The meat used in this experiment was fresh pork, consisting of a ham from a cross-bred Poland China-Berkshire hog, about 9 months old, which had been fattened for market on corn. The entire ham was placed in an open roasting pan and cooked four hours. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, 193° C. (380° F.) for one hour and forty-five minutes, and 160° C. (320° F.) for two hours longer. The time employed for the cooking averaged twenty-four minutes to the pound. The cooked meat was juicy and well done.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	4,932.80
Weight of meat after cooking	do	3,429.28
Loss in weight in cooking	do	1,503.52
Loss in weight in cooking	per cent	30.47
Weight of edible meat	grams	3,047.26

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 66.—*Results of cooking (roasting) experiment No. 93.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1574	1,689.02	747.15	592.36	31.99
In drippings and volatile matter	1574	961.34	23.13	511.04	7.04
In uncooked meat	1574a		770.28	1,103.40	39.03
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			97.00	53.69	81.96
In drippings and volatile matter			3.00	46.31	18.04
In drippings on basis of total weight of uncooked meat		19.49	.46	10.36	.14

COOKING EXPERIMENT NO. 94.

The meat used in this experiment was fresh pork, consisting of a ham from a Poland China hog, which had been fattened for market on oats, barley, and corn. The entire ham was placed in an open roasting pan and cooked for four hours. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, 193° C. (380° F.) for one hour and forty-five minutes, and 160° C. (320° F.) for two hours longer. The time employed for the cooking averaged twenty-five minutes to the pound. The cooked meat was well done and juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	4,153.19
Weight of meat after cooking	do	2,679.03
Loss in weight in cooking	do	1,474.16
Loss in weight in cooking	per cent	35.49
Weight of edible meat	grams	2,338.26

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 67.—*Results of cooking (roasting) experiment No. 94.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1575	1,201.84	605.13	525.16	23.15
In drippings and volatile matter	1575	871.73	23.75	570.98	7.29
In uncooked meat	1575a		628.88	1,096.14	30.44
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			96.22	47.91	76.05
In drippings and volatile matter			3.78	52.09	23.95
In drippings on basis of total weight of uncooked meat		20.99	.57	13.72	.17

COOKING EXPERIMENT NO. 95.

The meat used in this experiment was fresh pork, consisting of a ham from a well-fattened hog, about 9 months old, which had been fed on barley. The entire ham was placed in an open roasting pan and cooked for four hours. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, and 193° C. (380° F.) for the remaining time. The time employed for the cooking averaged 24.3 minutes to the pound.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams..	4,351.64
Weight of meat after cooking	do....	2,569.15
Loss in weight in cooking	do....	1,782.49
Loss in weight in cooking	per cent..	40.96
Weight of edible meat	grams..	2,255.46

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 68.—*Results of cooking (roasting) experiment No. 95.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1579	1,167.57	640.06	438.66	24.36
In drippings and volatile matter	1579	1,197.80	22.96	554.33	7.40
In uncooked meat	1579a		663.02	992.99	31.76
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			96.54	44.18	76.70
In drippings and volatile matter			3.46	55.82	23.30
In drippings on basis of total weight of uncooked meat		27.52	.53	12.77	.17

COOKING EXPERIMENT NO. 96.

in this experiment was the fifth rib from the right
old Aberdeen-Angus steer, fed on blue-grass pasture, corn, clover hay, and some supplementary nitrogenous feed. The entire piece was placed in an open roasting pan and cooked for one hour and forty-five minutes. The temperature of the oven was 243° C. (470° F.) for the first fifteen minutes, and 193° C. (380° F.) for the remaining time. The time employed for cooking averaged 19.4 minutes to the pound. The cooked meat was juicy and well done.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	2,445.14
Weight of meat after cooking	do	1,715.15
Loss in weight in cooking	do	729.99
Loss in weight in cooking	per cent	29.85
Weight of edible meat	grams	1,573.65

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 69.—*Results of cooking (roasting) experiment No. 96.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1587	552.66	306.86	706.88	12.43
In drippings and volatile matter	1587	382.70	9.34	334.99	2.96
In uncooked meat	1587a		316.20	1,041.87	15.39
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			97.13	67.85	80.77
In drippings and volatile matter			2.95	32.15	19.23
In drippings on basis of total weight of uncooked meat		15.65	.38	13.70	.42

COOKING EXPERIMENT NO. 97.

The meat used in this experiment was a rib from a well-fattened steer. The entire piece was placed in an open roasting pan and cooked for one hour and thirty-five minutes. The temperature of the oven was 240° C. (464° F.) for the first fifteen minutes, and 193° C. (380° F.) for the remaining time. The time employed for cooking averaged twenty-four minutes to the pound. The cooked meat was medium done, juicy, and tender.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	1,771.85
Weight of meat after cooking	do	1,282.82
Loss in weight in cooking	do	489.03
Loss in weight in cooking	per cent	27.59
Weight of edible meat	grams	1,169.16

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 70.—*Results of cooking (roasting) experiment No. 97.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1588	580.23	256.62	330.39	11.11
In drippings and volatile matter	1588	272.88	2.89	212.07	1.19
In uncooked meat	1588a	.....	259.51	542.46	12.30
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat	.....	.....	98.89	60.91	90.33
In drippings and volatile matter	.....	.....	1.11	39.09	9.67
In drippings on basis of total weight of uncooked meat	.....	15.40	.16	11.92	.07

COOKING EXPERIMENT NO. 98.

The meat used in this experiment was a rib from a well-fattened steer. The entire piece was placed in an open roasting pan and cooked for one hour and forty-five minutes. The temperature of the oven was 243° C. (470° F.) for the first fifteen minutes, and 193° C. (380° F.) for an hour and a half longer. The time employed for the cooking averaged 20.9 minutes to the pound. The cooked meat was well done and quite juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	2,310.48
Weight of meat after cooking	do	1,328.86
Loss in weight in cooking	do	981.62
Loss in weight in cooking	per cent	42.48
Weight of edible meat	grams	1,204.88

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 71.—*Results of cooking (roasting) experiment No. 98.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1589	337.57	264.32	597.56	10.48
In drippings and volatile matter	1589	574.10	3.16	403.03	1.33
In uncooked meat	1589a	.....	267.48	1,000.59	11.81
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat	.....	.....	18.82	59.72	88.74
In drippings and volatile matter	.....	.....	1.18	40.28	11.26
In drippings on basis of total weight of uncooked meat	.....	24.84	.13	17.44	.06

COOKING EXPERIMENT NO. 99.

The meat used in this experiment was a rib from a yearling Aberdeen-Angus steer, fed on blue-grass pasture, corn, clover hay, and some supplementary nitrogenous feed. The entire piece was placed in an open roasting pan and cooked for one hour. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, and 193° C. (380° F.) for the remaining time. The time employed for the cooking averaged 22.4 minutes to the pound. The cooked meat was rare done and very juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams..	1,601.75
Weight of meat after cooking	do....	1,275.73
Loss in weight in cooking	do....	326.02
Loss in weight in cooking	per cent..	20.35
Weight of edible meat	grams..	1,151.72

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 72.—*Results of cooking (roasting) experiment No. 99.*

	Laboratory No.	Water.	Protein.	Fat.	Asb.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1590	488.88	241.51	424.39	9.44
In drippings and volatile matter	1590	230.35	2.68	92.04	.95
In uncooked meat	1590a		244.19	516.43	10.39
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			98.90	82.18	90.86
In drippings and volatile matter			1.10	17.82	9.14
In drippings on basis of total weight of uncooked meat		14.38	.16	5.75	.06

COOKING EXPERIMENT NO. 100.

The meat used in this experiment was a rib from a well-fattened steer. The entire piece was placed in an open roasting pan and cooked for one hour and forty-five minutes. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, and 193° C. (380° F.) for the remaining time. The time employed for the cooking averaged sixteen minutes to the pound. The cooked meat was underdone or rare and very juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams..	2,997.95
Weight of meat after cooking	do....	2,285.65
Loss in weight in cooking	do....	712.30
Loss in weight in cooking	per cent..	23.75
Weight of edible meat	grams..	2,088.40

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 73.—*Results of cooking (roasting) experiment No. 100.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1614	695.43	341.24	1,045.02	15.45
In drippings and volatile matter	1614	478.41	2.99	229.66	1.24
In uncooked meat	1614a		344.23	1,274.68	16.69
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			99.13	81.99	92.57
In drippings and volatile matter			.87	18.01	7.43
In drippings on basis of total weight of uncooked meat		15.96	.10	7.66	.04

COOKING EXPERIMENT NO. 101.

The meat used in this experiment was a rib from a 2-year-old Aberdeen-Angus steer, fed on blue-grass pasture, corn, clover hay, and some supplementary nitrogenous feed. The entire piece was placed in an open roasting pan and cooked for one hour and twenty minutes. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes and 193° C. (380° F.) for the remaining time. The cooked meat was rare done and juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	2,197.09
Weight of meat after cooking	do	1,747.02
Loss in weight in cooking	do	450.07
Loss in weight in cooking	per cent	20.48
Weight of edible meat	grams	1,541.92

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 74.—*Results of cooking (roasting) experiment No. 101.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1615	705.21	280.91	547.17	14.18
In drippings and volatile matter	1615	329.58	1.15	118.82	.52
In uncooked meat	1615a		282.06	665.99	14.70
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			99.59	82.16	96.43
In drippings and volatile matter			.41	17.84	3.57
In drippings on basis of total weight of uncooked meat		15.00	.05	5.40	.02

COOKING EXPERIMENT NO. 102.

The meat used in this experiment was a rib from a yearling Aberdeen-Angus steer, fed on blue-grass pasture, corn, clover hay, and some supplementary nitrogenous feed. The entire piece was placed in an open roasting pan and cooked for one hour. The temperature of the oven was 254° C. (490° F.) for the first fifteen minutes and 193° C. (380° F.) for the remaining time. The cooked meat was underdone, or rare, and quite juicy.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	1,367.86
Weight of meat after cooking	do	1,194.22
Loss in weight in cooking	do	173.64
Loss in weight in cooking	per cent	12.68
Weight of edible meat	grams	1,067.87

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 75.—*Results of cooking (roasting) experiment No. 102.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1616	585.50	205.67	268.67	10.36
In drippings and volatile matter	1616	159.46	1.06	12.77	.35
In uncooked meat	1616a		206.73	281.44	10.71
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			99.49	95.47	96.73
In drippings and volatile matter			.51	4.53	3.27
In drippings on basis of total weight of uncooked meat		11.66	.08	.93	.02

COOKING EXPERIMENT NO. 103.

The meat used in this experiment was a rib from a young steer. The entire rib was placed in an open roasting pan and cooked in a gas-heated oven for one hour. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes and 193° C. (380° F.) for the remaining time. The time employed for the cooking averaged thirteen minutes to the pound. Before cooking the meat was seasoned with salt and pepper.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	1,474.17
Weight of meat after cooking	do	1,233.21
Loss in weight in cooking	do	240.96
Loss in weight in cooking	per cent	16.35
Weight of edible meat	grams	1,097.68

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 76.—*Results of cooking (roasting) experiment No. 103.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1629	485.42	192.83	410.16	8.57
In drippings and volatile matter	1629	157.10	3.04	76.72	4.10
In uncooked meat	1629a	.....	195.87	486.88	12.67
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat	.....	.....	98.48	84.24	67.64
In drippings and volatile matter	.....	.....	1.52	15.76	32.36
In drippings on basis of total weight of uncooked meat	.....	10.66	.21	5.20	.28

COOKING EXPERIMENT NO. 104.

The meat used in this experiment was a rib from a young steer. The entire rib was placed in an open roasting pan and cooked in a gas-heated oven for one hour. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, and 193° C. (380° F.) for the remaining time. The time employed for the cooking averaged fifteen minutes to the pound. The meat was seasoned with salt and pepper as in the preceding experiment.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams..	1,321.78
Weight of meat after cooking	do....	1,105.63
Loss in weight in cooking	do....	216.15
Loss in weight in cooking	per cent..	16.35
Weight of edible meat	grams..	949.52

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 77.—*Results of cooking (roasting) experiment No. 104.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1630	387.86	159.04	394.70	7.60
In drippings and volatile matter	1630	128.10	3.29	80.55	4.21
In uncooked meat	1630a	.....	162.33	475.25	11.81
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat	.....	.....	97.97	83.05	64.35
In drippings and volatile matter	.....	.....	2.03	16.95	35.65
In drippings on basis of total weight of uncooked meat	.....	9.69	.24	6.09	.32

COOKING EXPERIMENT NO. 105.

The meat used in this experiment was a rib from a young steer. The entire rib was placed in a closed roasting pan and cooked in a gas-heated oven for one hour. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, and 193° C. (380° F.) for the remaining time. The time employed for the cooking averaged fifteen minutes to the pound. The meat was seasoned with salt and pepper as in experiments Nos. 103 and 104.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	1,346.59
Weight of meat after cooking	do	1,006.41
Loss in weight in cooking	do	340.18
Loss in weight in cooking	per cent	25.27
Weight of edible meat	grams	862.09

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 78.—*Results of cooking (roasting) experiment No. 105.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1631	342.43	163.63	351.75	6.47
In drippings and volatile matter	1631	208.57	6.70	117.15	7.76
In uncooked meat	1631a	.....	170.33	468.90	14.23
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat	.....	.....	96.07	75.02	45.47
In drippings and volatile matter	.....	.....	3.93	24.98	54.53
In drippings on basis of total weight of uncooked meat	.....	15.49	.49	8.70	.58

COOKING EXPERIMENT NO. 106.

The meat used in this experiment was a rib from a young steer. The entire rib was placed in an open roasting pan and cooked in a gas-heated oven for one hour and fifteen minutes. The temperature of the oven was 249° C. (480° F.) for the first fifteen minutes, and 193° C. (380° F.) for the remaining time. The time employed for the cooking averaged twenty minutes to the pound. The meat was seasoned with salt and pepper before cooking.

The changes in weight of the meat due to cooking were as follows:

Weight of meat before cooking	grams	1,353.68
Weight of meat after cooking	do	946.15
Loss in weight in cooking	do	407.53
Loss in weight in cooking	per cent	30.10
Weight of edible meat	grams	827.50

The amounts and proportions of the nutrients of the cooked meat and drippings follow:

TABLE 79.—*Results of cooking (roasting) experiment No. 106.*

	Laboratory No.	Water.	Protein.	Fat.	Ash.
Weight of nutrients:		*Grams.*	*Grams.*	*Grams.*	*Grams.*
In edible cooked meat	1632	323.80	166.08	328.02	7.78
In drippings and volatile matter	1632	241.00	2.40	159.91	4.22
In uncooked meat	1632a		168.48	487.93	12.00
Proportion of nutrients:		*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
In edible cooked meat			98.58	67.23	64.83
In drippings and volatile matter			1.42	32.77	35.17
In drippings on basis of total weight of uncooked meat		17.80	.18	11.81	.31

SUMMARY AND DISCUSSION OF THE RESULTS OF THE ROASTING EXPERIMENTS.

The following tables summarize the results of all the experiments which have been made by the authors regarding the losses occasioned by roasting meat:

TABLE 80.—*Summary of the losses resulting in the roasting of meats.*

Cooking experiment No.	Laboratory No.	Kind of meat.	Weight of fresh meat taken.	Fat in edible uncooked meat.	Method of cooking.							Nutrients found in drippings expressed in percentages of total amounts in edible uncooked meat.				Nutrients in drippings expressed in percentages of the total weight of the edible uncooked meat.			
					Roasting in—	Total time.	Time per pound.	Temperature first 15 minutes.	Final cooking.				Water.	Protein.	Fat.	Ash.	Water.	Protein.	Fat.	Ash.
									Temperature.	Time.	Temperature.	Time.								
			Grams.	*Per ct.*		*H. m.*	*Min.*	°*C.*	°*C.*	*H. m.*	°*C.*	*H. m.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*
79	1491	Pork, ham	3,742.12	29.63	Covered pan	4 15	30	260	193	4 0			59.37	2.72	57.49	19.33	27.46	0.37	18.27	0.11
75	1483	do	4,124.84	23.38	do	3 45	25	249	193	2 0	160	1 30	39.03	1.75	34.37	10.89	21.13	.25	7.57	.08
		Average	3,933.48	26.50	do								49.20	2.23	45.93	15.11	24.29	.31	12.92	.09
76	1484	Pork, ham	3,642.90	31.92	Open pan	5 40	42	232	141	5 25			33.66	2.23	27.35	12.06	16.73	.25	7.85	.07
90	1558	do	6,013.61	17.09	do	4 30	20.3	249	193	2 0	160	2 15	42.58	2.70	50.29	19.17	23.98	.42	9.97	.14
89	1545	do	4,706.00	21.04	do	4 15	25	249	193	2 30	160	1 30	43.06	4.55	41.69	24.67	24.17	.70	8.96	.19
92	1573	do	4,344.55	19.73	do	4 0	25	249	193	1 30	160	2 15	41.07	4.51	45.43	27.18	22.27	.74	9.79	.22
94	1575	do	4,153.19	22.46	do	4 0	25	249	193	1 30	160	2 15	42.04	3.84	52.09	23.95	20.99	.58	13.72	.17
93	1574	do	4,932.80	19.44	do	4 0	24	249	193	1 30	160	2 15	36.27	3.12	46.31	18.04	19.49	.49	10.36	.14
95	1479	do	4,351.64	19.45	do	4 0	24.3	249	193	3 45			50.63	3.46	55.82	23.30	27.52	.53	12.77	.17
91	1559	do	4,294.94	17.36	do	4 0	25	238	193	2 0	160	1 45	34.98	2.58	43.30	14.29	19.89	.39	8.25	.11
82	1506	do	4,052.97	26.36	do	3 45	25	249	193	2 0	160	1 30	44.18	2.89	43.51	16.81	22.53	.40	11.71	.13
78	1489	do	3,940.57	29.80	do	3 30	25	249	193	2 0	160	1 15	37.79	2.82	44.14	17.17	17.29	.37	13.91	.11
81	1504	do	4,266.59	29.39	do	2 55	18.4	238	193	2 40			28.24	.86	38.19	6.26	13.50	.11	12.14	.04
80	1493	do	1,842.71	28.78	do	1 40	25	249	193	1 25			28.24	1.34	31.14	7.40	13.46	.17	8.63	.05
		Average	4,211.87	23.57	do								38.56	2.91	43.27	17.52	20.15	.43	10.67	.13
77	1486	Pork, ham	4,060.06	26.51	Open pan, basting every 15 minutes.	3 45	25	249	193	2 0	160	1 30	32.42	2.43	41 15	14.53	15.69	.34	11.78	.10
83	1511	do	3,961.83	21.20	do	3 45	25	249	193	2 0	160	1 30	37.42	1.95	49.08	12.50	19.86	.28	12.33	.09
		Average	4,010.94	23.85	do								34.92	2.19	45.11	13.51	17.77	.31	12.05	.09
		Pork, total average.	4,151.96	23.97									39.43	2.73	43.83	16.72	20.37	.40	11.13	.12
100	1614	Beef, ribs	2,997.95	50.04	Open pan	1 45	16	249	193	1 30			40.76	.87	18.01	7.43	15.96	.10	7.66	.04
98	1589	do	2,310.48	49.60	do	1 45	20.9	243	193	1 30			62.97	1.18	40.28	11.26	24.84	.13	17.44	.06
96	1587	do	2,445.14	44.92	do	1 45	19.4	243	193	1 30			40.91	2.95	32.15	19.23	15.65	.38	13.70	.12
97	1588	do	1,771.85	28.26	do	1 35	24	240	193	1 20			31.99	1.11	39.09	9.67	15.40	.16	11.92	.07
84	1536	do	1,895.84	39.60	do	1 25	20.1	249	193	1 10			35.73	.62	26.25	5.70	15.33	.08	9.60	.04
86	1538	do	1,963.20	51.32	do	1 25	19.4	249	193	1 10			41.05	.25	26.56	2.47	15.34	.03	12.42	.01

TABLE 80.—*Summary of the losses resulting in the roasting of meats*—Continued.

Cooking experiment No.	Laboratory No.	Kind of meat.	Weight of fresh meat taken.	Fat in edible uncooked meat.	Method of cooking.								Nutrients found in drippings expressed in percentages of total amounts in edible uncooked meat.				Nutrients in drippings expressed in percentages of the total weight of the edible uncooked meat.			
					Roasting in—	Total time.	Time per pound.	Temperature first 15 minutes.	Final cooking.				Water.	Protein.	Fat.	Ash.	Water.	Protein.	Fat.	Ash.
									Temperature.	Time.	Temperature.	Time.								
			Grams.	*Per ct.*		*H. m.*	*Min.*	° *C.*	° *C.*	*H. m.*	° *C.*	*H. m.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
85	1537	Beef, ribs	2,112.04	32.08	Open pan	1 25	18.2	249	193	1 10			23.22	0.55	20.01	4.39	10.91	0.08	6.09	0.03
99	1590	do	1,601.75	36.85	do	1 20	22 4	249	193	1 5			32.03	1.10	17.82	9.14	14.38	.17	5.75	.06
101	1615	do	2,197.09	35.49	do	1 20	16 4	249	193	1 5			31.84	.41	17.84	3.57	15.00	.05	5.40	.02
87	1539	do	1,856.89	18.34	do	1 15	18.2	249	193	1 0			20.95	.40	38.45	3.91	11.83	.05	8.13	.02
88	1540	do	1,856.89	24.23	do	1 15	18.2	249	193	1 0			27.04	.49	23.90	4.14	14.89	.06	5.44	.03
102	1616	do	1,367.86	25.16	do	1 0	20	254	193	45			21.41	.51	4.53	3.27	11.66	.08	.93	.02
		Average	2,031.41	36.32	do								34.16	.87	25.41	7.01	15.10	.11	8.71	.04
103	1629	Beef, ribs	1,474.17		do	1 0	13	249	193	45			24.45	1.52	15.76	32.36	10.66	.21	5.20	.28
104	1630	do	1,321.78		do	1 0	15	249	193	45			24.83	2.03	16.95	35.65	9.69	.24	6.09	.32
105	1631	do	1,346.59		Covered pan	1 0	15	249	193	45			37.85	3.93	24.98	54.53	15.49	.49	8.70	.58
106	1632	do	1,353.68		Open pan	1 15	20	249	193	1 0			42.67	1.42	32.77	35.17	17.80	.18	11.81	.31
		Average	1,374.05										32.45	2.22	22.61	39.43	13.41	.28	7.95	.37
		Beef, total average.	1,867.07	36.32									33.73	1.21	24.71	15.12	14.68	.15	8.52	.12
		Pork and beef, average.	3,009.52	30.15									36.58	1.97	34.27	15.92	17.53	.28	9.83	.12

CONDITION OF COOKED MEAT.

No. 79. Meat dry and overcooked, exposed lean overbrowned, fat well browned.
No. 75. Ham in poor condition.
No. 76. Very light brown, underdone, juicy.
No. 90. Center very juicy, slightly undercooked in upper round.
No. 89. Somewhat overcooked, considerable juice.
No. 92. Well done, juicy.
No. 94. Well done, juicy, rather stringy.
No. 93. Well done, juicy.
No. 91. Well done, juicy.
No. 82. Very well done, juicy.
No. 78. Well cooked, very juicy, browned, but not hard.
No. 81. Center underdone, very juicy.
No. 80. Well browned, very juicy, underdone.
No. 77. Well browned, well done, and juicy.
No. 83. Well done, fairly juicy.
No. 100. Rare, very juicy.
No. 98. Well done, quite juicy.
No. 96. Well done, juicy.
No. 97. Medium, juicy, and tender.
No. 84. Rather tough and dry, small quantity, red-brown juice.
No. 86. Well done, no pink color in flesh, juice scanty and brown.
No. 85. Center medium, medium quantity of red juice.
No. 99. Medium, not very juicy.
No. 101. Rare, juicy.
No. 87. Good standard, outside brown, inside bright pink, medium quantity of red juice.
No. 88. Center rare, considerable amount of red juice.
No. 102. Rare, quite juicy. This and all the preceding meats were not seasoned.
No. 103. Rare and quite juicy; seasoned with salt and pepper.
No. 104. Medium well done, fairly juicy; seasoned with salt and pepper.
No. 105. Well done, dry; seasoned with salt and pepper.
No. 106. Very well done, dry; seasoned with salt and pepper.

TABLE 81.—*Summary of losses in drippings and in volatilized matter, as a result of roasting meats.*

[Results expressed in per cent of the weight of the uncooked meat.]

Laboratory No.	Cooking Exp. No.	Kind of meat.	Loss in—		Total loss.
			Drippings.	Volatilized matter.	
			Per cent.	*Per cent.*	*Per cent.*
1483	75	Pork, ham	7.91	21.13	29.04
1484	76	.....do	8.17	16.73	24.90
1486	77	.....do	12.22	15.69	27.91
1489	78	.....do	14.39	17.29	31.68
1491	79	.....do	18.75	27.46	46.21
1493	80	.....do	8.84	13.46	22.30
1504	81	.....do	12.29	13.48	25.77
1506	82	.....do	12.24	22.53	34.77
1511	83	.....do	12.70	19.85	32.55
1536	84	Beef, rib	9.71	15.32	25.03
1537	85	.....do	6.21	10.90	17.11
1538	86	.....do	12.45	15.34	27.79
1539	87	.....do	8.20	11.83	20.03
1540	88	.....do	5.54	14.88	20.42
1545	89	Pork, ham	9.86	24.17	34.03
1558	90	.....do	10.54	22.32	32.86
1559	91	.....do	8.74	19.80	28.54
1573	92	.....do	10.76	22.27	33.03
1574	93	.....do	10.99	19.48	30.47
1575	94	.....do	14.51	20.98	35.49
1579	95	.....do	13.44	27.52	40.96
1587	96	Beef, rib	14.20	15.65	29.85
1588	97	.....do	12.19	15.40	27.59
1589	98	.....do	17.63	24.85	42.48
1590	99	.....do	5.97	14.38	20.35
1614	100	.....do	7.80	15.95	23.75
1615	101	.....do	5.48	15.00	20.48
1616	102	.....do	1.03	11.65	12.68
1629	103	.....do	6.97	9.38	16.35
1630	104	.....do	7.77	8.58	16.35
1631	105	.....do	13.69	11.58	25.27
1632	106	.....do	12.30	17.80	30.10
		Total average	10.19	16.63	26.82

In the roasting experiments here reported, including 16 tests in which pork was used and 16 tests in which beef was used, the total loss in weight resulting from this method of cooking varied from 12.68 per cent to 46.21 per cent of the total weight of the fresh meat, the average for all of the experiments being 26.82 per cent. The total losses resulting from this method of cooking were considerably less than those resulting from boiling, sautéing, and panbroiling. In the 42 boiling experiments reported above the total loss in weight due to this process of cooking varied from 10 to 50 per cent of the weight of the fresh meat, the average of all the experiments being 34.35 per cent.

The nature of this total loss is quite different in the roasting experiments from that occurring in boiling, in sautéing, and in panbroiling. In the case of the last three methods of cooking the greater part of the loss is due to water, but in the case of the first the main loss is distributed between the water and fat. In other words, in the experiments here reported the loss of the fat resulting when meat is roasted is much greater than when it is boiled. In the case of the 32 roasting experiments the average loss of water amounted to 17.53 per cent and the average loss of fat amounted to 9.83 per cent of the total weight of the edible portion of the uncooked meat. In the 91 boiling experiments the average loss of water amounted to 30.75 per cent and the average loss of fat to only 1.21 per cent of the total weight of the edible portion of the uncooked meat. However, the meats used in the roasting experiments were much fatter as a rule than those used in the boiling experiments, and it is possible that the presence of this greater quantity of fat would decrease the losses taking place in the cooking.

The amount of water removed in the roasting of these meats varied from 10.91 per cent to 27.52 per cent, averaging 17.53 per cent of the original uncooked meat. The smallest loss of water occurred in cooking experiment No. 85, in which medium fat beef rib, laboratory No. 1537, was cooked for one hour and twenty-five minutes. The meat was only "medium well done," and there was a considerable quantity of red juice in the pan. The greatest loss of water occurred in cooking experiment No. 95, in which a medium fat ham, laboratory No. 1579, was cooked for fifteen minutes at 249° C., and for three hours and forty-five minutes at 193° C.

It will be observed that in roasting the 16 samples of pork the average loss of water (20.37 per cent of the uncooked meat) was considerably greater than in roasting the 16 samples of beef (14.68 per cent). This probably was due to the longer cooking in the case of the pork. Considering the fact that the beef samples contained more fat than the pork and that the time of the cooking in the case of the pork was generally three times as long as in the case of the beef, it seems strange that the loss of water noted in roasting the pork was not greater.

The nitrogenous matter lost in the cooking varied from 0.25 to 4.55 per cent, the average in the 32 tests being 1.97 per cent of the entire quantity of nitrogenous matter contained in the edible portion of the uncooked meat. By referring to the average results obtained in the boiling experiments (Table 39, p. 46), it will be seen that this investigation indicates clearly that the loss of nitrogenous matter taking place when meats are boiled is more than 50 per cent greater than when they are roasted. The greatest loss of nitrogenous matter observed when the meats were boiled was 12.67 per cent, the lowest 3.25 per cent, and the average 7.25 per cent, of the total weight of nitrogenous matter present in the uncooked meat. In the experiments here reported the losses of nitrogenous matter caused by roasting are greater in the case of pork than in the case of beef. The average loss of nitrogenous matter in the 16 roasting experiments with pork was 2.73 per cent, while in the 16 experiments with beef it was 1.21 per cent of the total nitrogenous matter in the edible portion of the uncooked meat.

The amount of fat which was melted out of the meat during the process of roasting varied from 4.53 to 57.49 per cent, and averaged 34.27 per cent of the entire quantity present in the original uncooked meat. While the loss of water and nitrogenous matter observed in roasting meats is much smaller than the corresponding losses in boiling, the loss of fat, on the other hand, is much greater. The greatest loss of fat in the boiling experiments was 37.40 per cent, the lowest 0.60 per cent, and the average 11.70 per cent of the weight of the total fat in the uncooked meat. The average loss of fat in the roasting experiments was almost three times as much as the average loss in the boiling experiments. However, we must remember that the meats used in the roasting experiments were much fatter than those used in the boiling experiments.

The proportion of the fat lost when pork was roasted was much greater than the loss with beef. The average loss of fat in the 16 roasting experiments with pork amounted to 43.83 per cent, while in the 16 roasting experiments with beef it amounted to only 24.71 per cent of the total fat in the edible portion of the uncooked meat.

The mineral matter found in the drippings in the experiments varied from 2.47 to 27.18 per cent, averaging in the 28 experiments in which no seasoning was used, 11.87 per cent of the entire mineral matter contained in the meat before cooking. By referring to Table 39, page 46, it will be observed that the values thus far obtained show plainly that the loss of mineral substances taking place in the boiling of meats is 32.76 per cent greater than when meats were roasted. It also appears that the losses of mineral matter when pork is roasted are greater than in corresponding tests with beef, the average loss of ash with the pork being 16.72, and with the beef (when no seasoning was used) only 7.01 per cent of the total amount in the meat before cooking.

From the limited number of experiments here reported, definite and final conclusions can not be drawn, but certain deductions seem to be indicated clearly by the data at present available. The results of the experiments summarized in Table 80 show something of the influence of different methods of roasting meat upon the losses which occur. The total losses were greater when the meats were roasted in a covered pan than when they were cooked in open pans, owing chiefly to the increased amount of water removed. The meat was more thoroughly cooked in the same time and at the same temperature in the covered than in the open pans, possibly because the temperature of the meat was higher in the closed pan. These results confirm the conclusions drawn by Prof. Isabel Bevier and Miss Elizabeth C. Sprague[a] from a large number of similar experiments.

Basting the meat every fifteen minutes during the roasting apparently decreased the loss of water, salts, and nitrogenous matter, although the total loss of nutrients did not differ greatly, owing to the slightly increased loss of fat. This conclusion agrees with the commonly accepted belief that basting tends to retain the meat juices, but is not in accord with the results of the experiments referred to above.[a] However, the cuts of pork used in the experiments here reported were considerably larger and required a much longer time for cooking than the one-rib beef roasts, which were used by Miss Bevier and Miss Sprague.

The losses in roasting increase in direct proportion to the amount of cooking. In other words, the more thoroughly the meat is cooked the greater are the losses which it undergoes. That this is true can be seen by studying the data given in Table 82.

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[a] Illinois Experiment Station Circ. 71.

TABLE 82.—*Influence of degree of cooking upon losses resulting by roasting beef.*

Laboratory No.	Kind of meat.	Weight of meat taken.	Total time of cooking.	Time per pound.	Per cent fat in edible uncooked meat.	Constituents in drippings expressed in percentages of total amounts in uncooked meat.				Constituents in drippings expressed in percentages of total weight of uncooked meat.			
						Water.	Protein.	Fat.	Ash.	Water.	Protein.	Fat.	Ash.
		Grams.	*H. m.*	*Min.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*	*Perct.*
1614	Beef, rare and very juicy..	2,997.95	1 45	16	45.72	40.75	0.87	18.01	7.43	15.96	0.10	7.66	0.04
1616	Beef, rare and quite juicy..	1,367.86	1 00	20	22.49	21.41	.51	4.53	3.27	11.66	.08	.93	.02
1540	.....do.....	1,856.89	1 15	18.2	21.76	27.04	.49	23.90	4.14	14.89	.06	5.44	.03
1615	.....do.....	2,197.09	1 20	16.4	31.32	31.85	.41	17.84	3.57	15.00	.05	5.40	.02
1539	.....do.....	1,856.89	1 15	18.2	16.28	20.95	.40	38.45	3.91	11.83	.05	8.13	.02
	Average.	2,055.34	.....	.....	27.51	28.40	.53	20.55	4.46	13.87	.07	5.51	.03
1537	Beef, medium.	2,112.04	1 25	18.2	29.37	23.22	.55	20.01	4.39	10.91	.08	6.09	.03
1588	.....do.....	1,771.85	1 35	24	25.75	31.99	1.11	39.09	9.67	15.40	.16	11.92	.07
1590	.....do.....	1,601.75	1 20	22.4	33.26	32.02	1.10	17.82	9.14	14.38	.16	5.75	.06
	Average.	1,828.55	.....	.....	29.46	29.08	.92	25.64	7.73	13.56	.13	7.92	.05
1538	Beef, well done.....	1,963.20	1 25	19.4	47.55	41.05	.25	26.56	2.47	15.34	.03	12.42	.01
1587	.....do.....	2,445.14	1 45	19.4	41.21	40.82	2.95	32.15	19.23	15.65	.38	13.70	.12
1589	.....do.....	2,310.48	1 45	20.9	44.97	62.97	1.18	40.28	11.26	24.84	.13	17.44	.06
1536	.....do.....	1,895.84	1 25	20.1	35.97	35.73	.62	26.25	5.70	15.33	.08	9.60	.04
	Average.	2,153.67	.....	.....	42.42	45.14	1.25	31.31	9.66	17.79	.15	13.29	.06

The average for the five roasts cooked until underdone or rare shows a loss of 28.40 per cent of the water and 20.55 per cent of the fat present in the edible portion of the meat before cooking. The average losses in the three experiments in which the meats were "medium well done" were 29.08 per cent of the water and 25.64 per cent of the fat originally present. In the case of the four roasts which were cooked until well done, the average loss of water was 45.14 per cent, and the average loss of fat 31.31 per cent of the entire weights of these constituents in the portion of the uncooked meat. It will also be observed from the data recorded that with the increase in the time and temperature of cooking the loss of nitrogenous matter and ash increases in about the same proportion as does that of water and fat.

The results expressed in percentages of the total weight of uncooked meat also show that the greater losses occur in meat which has been cooked for the longer time. The average results obtained with the five rare or underdone roasts show a loss of 13.87 per cent of water, 5.51 per cent of fat, 0.07 per cent of nitrogenous matter, and 0.03 per cent of ash. The average losses obtained with well-done roasts were 13.56 per cent of water, 7.92 per cent of fat, 0.13 per cent of nitrogenous matter, and 0.05 per cent of ash. The average losses obtained when the roasts were cooked until well done were 17.79 per cent of water, 13.29 per cent of fat, 0.15 per cent of nitrogenous matter, and 0.06 per cent of ash.

The results given in Table 80 for beef cooked with and without seasoning seem to confirm the theory that salting meat before and during cooking draws out the juices and increases the loss of nitrogenous matter. Nos. 103 to 106 were seasoned with salt and pepper; the others were cooked without seasoning. The amounts of water and fat lost in those meats which were salted were somewhat less than the corresponding losses in unsalted meats. The amount of ash removed is of course necessarily more in the case of the seasoned meat because of the presence in the drippings of part of the added salt.

CONCLUSIONS.

Much more study is required of the losses dependent upon the cooking of meats and of the chemical changes involved before definite or final deductions can be drawn. Some conclusions, however, seem warranted. In general, it may be said that the data given in the preceding pages confirm the conclusions stated in a previous bulletin[a] of this Office upon this subject, and also leads to some further deductions. Briefly stated the results of all the tests indicate that—

(1) The chief loss in weight during the boiling, sautéing, and panbroiling of meats is due to water removed by the heat of cooking. In the roasting of meats the chief loss is due to the removal of both water and fat.

(2) The losses of nutritive material in the panbroiling of meats are very small as compared with the losses which take place in boiling, roasting, and sautéing.

(3) When beef was cooked in water in these experiments, 3.25 to 12.67 per cent of the nitrogenous matter, 0.60 to 37.40 per cent of the fat, and 20.04 to 67.39 per cent of the mineral matter of the original uncooked meat were found in the broth. The nutritive material thus removed has been designated as a loss, but is not an actual loss if the broth is utilized for soup or in other ways.

(4) The experiments here reported show that when meat is sautéed 2.15 per cent of the nitrogenous matter and 3.07 per cent of the ash occurring in the uncooked meat were taken up on an average by the fat in which the meat was cooked, while the cooked meat contained 2.3 times more fat than before cooking.

(5) When the meats were roasted, 0.25 to 4.55 per cent of the nitrogenous matter, 4.53 to 57.49 per cent of the fat, and 2.47 to 27.18 per cent of the mineral matter present in the uncooked meat were found in the drippings.

(6) Beef which has been used for the preparation of beef tea or broth has lost comparatively little in nutritive value, though much of the flavoring material has been removed.

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[a] U. S. Dept. Agr., Office of Experiment Stations Bul. 102.

(7) In the boiling of meats, the fatter kinds and cuts, other things being the same, lost less water, nitrogenous and mineral matter, but more fat than the leaner kinds and cuts.

(8) In cooking meats by boiling, sautéing, panbroiling, and roasting, the losses increased in proportion to the degree of cooking. In other words, the longer the time and the higher the temperature of cooking, other things being the same, the greater the losses resulting.

(9) As a rule, the larger the piece of meat cooked by the methods of boiling and roasting, the smaller were the relative losses.

(10) The experiments indicate plainly that different cuts of the same kind of meat behave very differently as regards the amount and nature of the losses which they undergo when cooked in hot water.

(11) Thorough investigation confirms the conclusion that when meat is cooked in water at 80° to 85° C., placing the meat in hot or cold water at the start has little effect on the amount of material found in the broth.

(12) The nature of the nitrogenous constituents and the so-called "other substances" of meats and broths is as yet not fully understood, although a very large amount of time has been devoted to the study of these groups in connection with this investigation.

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